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NATIONAL DAM SAFETY PROGRAM. INDIAN LAKE DAM (NJ00167), PASSAIC--ETC(U)
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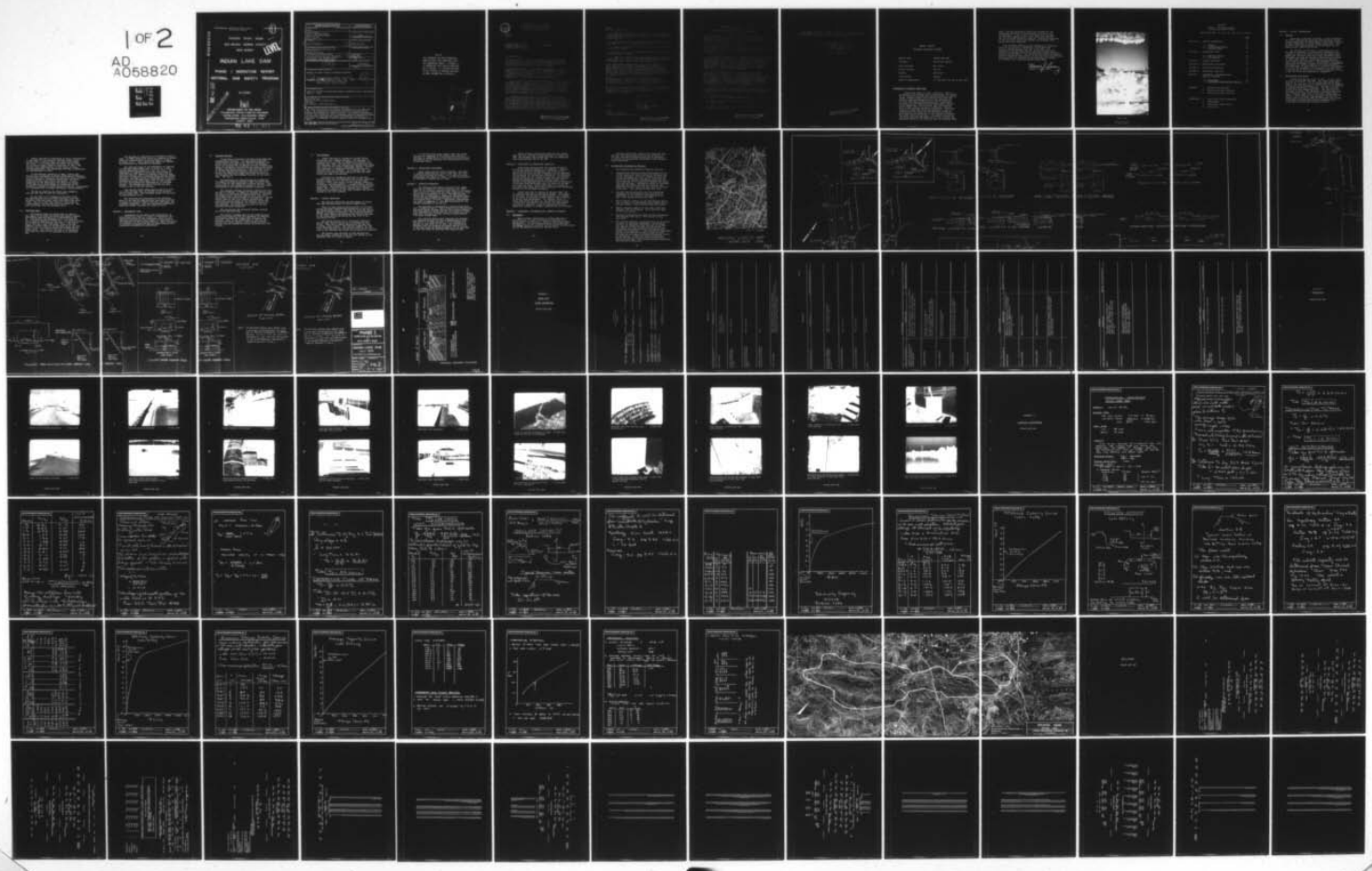


PASSAIC RIVER BASIN

DEN BROOK, MORRIS COUNTY

NEW JERSEY

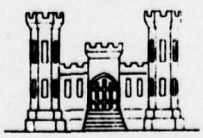
LEVEL

INDIAN LAKE DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NJ 00167



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

AUGUST 1978

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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National Dam Safety Program
Indian Lake Dam
Morris County, N.J.

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7. AUTHOR(s): Dennis J. Leary P.E.

8. CONTRACT OR GRANT NUMBER(s): DACW61-78-C-0124

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
Langan Engineering Associates, Inc.
970 Clifton Ave.
Clifton, N.J. 07013

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:

11. CONTROLLING OFFICE NAME AND ADDRESS:
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Custom House, 2d & Chestnut Streets
Philadelphia, Pennsylvania 19106

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National Dam Safety Program. Indian Lake Dam [redacted] (NJ00167), Passaic River Basin, Den Brook, Morris County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*
Dams--New Jersey
National Dam Safety Program Phase I
Dam Safety
Dam Inspection, Indian Lake Dam N.J.

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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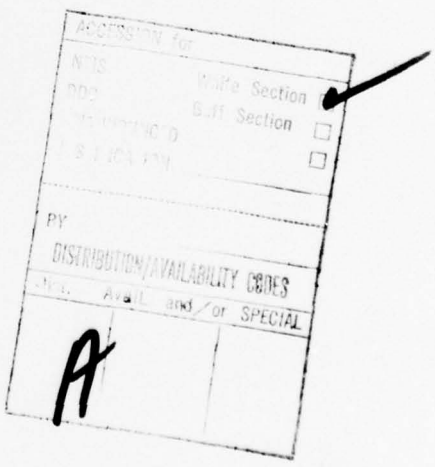

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

1 SEP 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Indian Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given on the first four pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Indian Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the dam's spillway is considered seriously inadequate since 21 percent of the Probable Maximum Flood (PMF) would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1979. In the interim, a detailed emergency operation plan warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within three months from the date of approval of this report engineering studies and analysis should be performed to determine the condition and effectiveness of the timber sheet pile cutoff along the upstream face of the spillway. This should include necessary borings, test pits, etc. as required to determine the nature of the spillway foundation materials and the condition of the connection between the cutoff wall and spillway. Piezometers should also be installed upstream and downstream of the spillway and monitored during a time when the lake is normally drawn down.

2

c. Within three months from the date of approval of this report the owner of Lake Estling should make necessary repairs to its spillway to ensure its satisfactory performance during extreme floods as it effects the performance of Indian Lake Dam.

d. The following remedial measures should be completed within the below listed times from the date of approval of this report:

(1) Within three months provide erosion protection for the downstream abutments of the spillway.

(2) Within one year repair the concrete support for the floor stand gate operator and the bulkhead.

(3) Within three months evaluate alternative locations for the 12 inch diameter sewer pipe supported by a steel beam beneath the spillway bridge. Floating debris could catch on it and obstruct the spillway.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congresswoman Helen S. Meyner of the Thirteenth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Cy furn:
Mr. Dirk C. Hofman, P.E.
Department of Environmental Protection

INDIAN LAKE DAM (NJ00167)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 27 June also 5, 12 and 19 July by Langan Engineering Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

The Indian Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the dam's spillway is considered seriously inadequate since 21 percent of the Probable Maximum Flood (PMF) would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1979. In the interim, a detailed emergency operation plan warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within three months from the date of approval of this report engineering studies and analysis should be performed to determine the condition and effectiveness of the timber sheet pile cutoff along the upstream face of the spillway. This should include necessary borings, test pits, etc. as required to determine the nature of the spillway foundation materials and the condition of the connection between the cutoff wall and spillway. Piezometers should also be installed upstream and downstream of the spillway and monitored during a time when the lake is normally drawn down.

c. Within three months from the date of approval of this report the owner of Lake Estling should make necessary repairs to its spillway to ensure its satisfactory performance during extreme floods as it effects the performance of Indian Lake Dam.

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(2) Within one year repair the concrete support for the floor stand gate operator and the bulkhead.

(3) Within three months evaluate alternative locations for the 12 inch diameter sewer pipe supported by a steel beam beneath the spillway bridge. Floating debris could catch on it and obstruct the spillway.

APPROVED: James C. Ton
JAMES C. TON
Colonel, Corps of Engineers
District Engineer

DATE: 1 Sep 75

PHASE 1 REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	INDIAN LAKE DAM
ID Number :	Fed ID No. NJ00167
State Located:	New Jersey
County Located:	Morris
Stream:	Den Brook
River Basin:	Passaic
Date of Inspections:	27 June and 5,12 and 19 July 1978

ASSESSMENT OF GENERAL CONDITIONS

Indian Lake Dam is in fair condition. There is a possibility of seepage under the spillway and erosion of the downstream toe of the spillway during an extreme flood. Because Indian Lake receives flow from Lake Estling, some maintenance work on the abutments of the arch spillway of Estling Lake Dam is necessary to ensure its satisfactory performance under extreme flood conditions. The condition and effectiveness of the timber sheet pile cutoff along the upstream face of the spillway should be determined. This will require at least one boring and possibly a test pit to determine the nature of the spillway foundation materials and the condition of the connection between the cutoff wall and spillway. Piezometers should be installed upstream and downstream at the spillway and monitored during a time when the lake is normally drawn

down. Erosion protection should be provided for the downstream abutments of the spillway to prevent loss of embankment in the event of overtopping of the dam. The concrete support to the floor stand gate operator and the bulkhead should be repaired. Aternative locations of the 12-in-dia sewer pipe between the spillway side walls should be evaluated.

The spillway capacity as determined by CE screening criteria is seriously inadequate. We estimate the dam can adequately pass only 20% of the PMF. The capacity of the spillway and the spillway design flood should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established.

Dennis J. Leary

Dennis J. Leary, P.E.

OVER VIEW

INDIAN LAKE DAM
21 June 1978

CONTENTS

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

INDIAN LAKE DAM N.J. NO. 34 FED. ID No. NJ00167

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I safety inspection of Indian Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 May 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367.

The purpose of the Phase I investigation is to develop an assessment of the general conditions with respect to safety of Indian Lake Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment has been made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection to imply that a dam meeting or failing to meet the screening criteria, is per se, certainly adequate or inadequate.

1.2 Description of Project

Indian Lake Dam was built in 1921. It is a 340-ft-long, 15-ft-high earth dam. The crest width varies from 27 ft to 52 ft. It is located along North Shore Road at the northeast end of Indian Lake in the Township of Denville, Morris County, N.J. The dam is at 40°53.5' lattitude and 74°28.9' longitude. The dam includes a free fall ogee shaped spillway. The length of the spillway is 40 ft. The spillway is covered downstream by a concrete bridge that is five feet above water level. Indian Lake is fed from above by Lake Estling which in turn is fed by Lake Shongum. The area of Indian Lake is 88 acres and the watershed area is 4740 acres which includes Lake Estling catchment area. A regional vicinity map is given in Fig. 1.

2

Indian Lake Dam is classified as being "Intermediate" on the basis of its reservoir storage volume, which is more than 1,000-acre feet, but less than 50,000-acre feet. It is classified as "Small" on the basis of its total height, which is less than 40 feet. The overall size classification is the larger of these two determinations, and accordingly the dam is classified as "Intermediate" in size.

In the National Inventory of Dams, Indian Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection of the downstream area shows that breach of the dam would cause damage to residences and be hazardous to people utilizing Routes 80 and 46. Accordingly, It is proposed not to change the Hazard Classification.

The dam is owned by the Indian Lake Community Club and the lake is used for recreation.

At the time of our inspection the water level was approximately one inch above spillway crest and tailwater level was about seven feet below lake water level. The tail race water level is controlled by a pond between the dam and Interstate Route 80. The pond discharges into the Rockaway River.

1.3 Pertinent Data

The maximum length of Indian Lake is 3600 ft. The length of the pool and downstream channel between North Shore Road and Route 80 is approximately 800 ft. The spillway was designed for a 3 ft head and has a reported capacity of 1065 cfs. Two bottom outlets are located at the spillway side walls. The outlet pipes, 2-ft-dia. cast iron pipes, lead to 30-inch diameter control gates at the abutment walls and then into 2 ft by 2 ft culverts which run through the abutment walls. The crest of the dam is at elevation 513.5 and the crest of the spillway is at elevation 508.

The spillway is reported to be founded on medium sand. A timber sheet pile cutoff is reported to extend below the upstream face of the spillway to a depth of about 4.5 ft. This information should be checked. The references are difficult to decipher.

The upstream slope of the embankment is reported to have been constructed with a 2.5 hor to 1 vert. and the downstream slope at a 2 hor to 1 vert. The embankment is reported to have been constructed of sand and clay soil spread in shallow layers and compacted by rolling with a weighted down traction engine that gave a contact stress of approximately 30 lb/in^2. Presently, the upstream side of the dam has a concrete bulkhead and stone faced upper wall at the highway. The wall and bulkhead are separated by a 7-ft-wide walkway. The downstream side of the dam has been filled in and is used for parking.

Lake Estling feeds Indian Lake by way of a free fall arch spillway that is located at the southern end of Indian Lake. The developed length of the crest is approximately 30 ft.

The locations and elevations of the different parts of the dam and appurtenances have been obtained by means of surveyors transit and rod, USGS Maps, and reference documents. They are considered approximate. Essential Project Features are given in Fig 2.

SECTION 2 ENGINEERING DATA

Information on the design and construction is very limited and there is a lack of information concerning the nature of the foundation, which is very important particularly with respect to evaluation of the stability of the spillway section. What information is available indicates the dam and appurtenances were responsibly designed and constructed.

2.1 Regional Geology

Indian Dam is located in the New Jersey Highlands physiographic province. The New Jersey Highlands extend across the State in a northeast-southwest direction from the border of New York to the Delaware River and includes the northwest portions of Hunterdon, Passaic, and Morris Counties and the southeastern parts of Warren and Sussex Counties. This province is part of the New England Physiographic Province and lies between the Appalacian Ridge and Valley Province to the northwest and the Piedmont Province to the southeast. See Fig 3.

The Highlands are characterized by rounded and flattopped northeast-southwest ridges and mountainas up to 1,400 ft high separated by narrow valleys. The orientation of the valleys are usually, but not always controlled by the underlying geologic structure.

The regional geologic structure reflects the very old age of bedrock. A number of regional faults cross the area in a northeast southwest direction, including the Ramapo Fault; the more than 30 mile long fault scarp forms the eastern border of the province. Faults control many of the river valley orientations. The relatively uniform slope of the mountain elevations, from northwest to southeast, is a direct result of the faulting. The entire area is part of the now dissected Schooley Peneplain.

The Pleistocene Age Wisconsin glacier covered all of the dam site area.

The glacier stripped most of the existing overburden and weathered rock and uncovered the numerous hard bedrock knobs and ridges seen throughout the province. Most of the side-slopes in the area are covered with heavy boulder tills (ground moraine), whereas glacial outwash and recent alluvium cover the valleys.

2.2 Site Geology

Indian Lake Dam is located on a broad valley bottom near the terminal moraine. The dam area is urbanized with a number of commercial buildings, residences and roads. The terrain, particularly on the left abutment, has been extensively reworked and graded and little of the natural topography remains. On the right abutment, a commercial building has been constructed into the hillside. It is assumed that rock excavation would have been prohibitive and the excavation was made in overburden.

Although the foundation material on the left abutment could not be determined from surface exposures, natural slopes of up to 24° do exist on the right abutment. This lope appears to be composed primarily of glacial outwash material, a rounded cobbly, gravelly, silty sand. The Engineering Soil Survey of New Jersey (Report No. 9, Morris County) reports that residual soils may be possible on the right abutment and glacial outwash on the left abutment.

SECTION 3 VISUAL INSPECTION

The general conditions and maintenance of Indian Lake Dam and appurtenant structures appear good.

There is some concrete deterioration in the downstream spillway sidewalls and weathering at the spillway construction joints, otherwise the spillway section appears in adequate condition. The concrete bulkhead at the right side of the spillway has cracked and some of the stone facing has fallen out but this is not considered serious.

The bottom outlets are in functional condition and the gate valves seem to be in satisfactory condition. They can be easily operated by one man with a ratchet lever handle. The concrete support for the floor stand operator for the control valve at the left side of the spillway has broken up and should be repaired.

The masonry arch spillway at Lake Estling has had the mortar washed out from the rock blocks at the abutments and is in need of repair.

A 12-in-dia sewer pipe passes under the bridge between the sidewalls of the Indian Lake spillway. The pipe is supported by a steel beam and could cause obstruction of the spillway by floating debris during an extreme flood.

SECTION 4 OPERATIONAL PROCEDURES

Water levels are not being recorded. The lake is lowered approximately twice a year when the level rises during storms and every 3 or 4 years to allow maintenance and repair of docks. No flow measurements or systematic inspections are made.

SECTION 5 HYDRAULIC/HYDROLOGY

The hydraulic/hydrologic evaluation for Indian Lake Dam is based on a spillway design flood (SDF) equal to the probable maximum flood (PMF) in accordance with evaluation guidelines for dams classified as high hazard and intermediate in size. The PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 22.5 inches (200 square mile - 24 hour). Hydrologic computations are given in Appendix 3. The PMF determined for the subject watershed is 16,448 cfs.

The spillway is essentially a broad crested weir with a length of 40 ft. After flowing over the spillway the water passes through the dam via a bridge opening with dimensions of 40-ft-wide by 11-ft-high to a small pond with its water surface elevation approximately 7 ft below Indian Lake.

The original design data indicates the spillway was designed to pass a flood of approximately 1100 cfs with a 3 ft head and with 1 ft of freeboard remaining to the crest of the dam. Our calculations indicate with the existing available head of 5.5 ft to the dam crest the maximum capacity of the spillway is 1702 cfs which is less than the required SDF.

Flood routing calculations indicate that Indian Lake Dam will overtop by approximately 4 ft under the PMF. We estimate that Indian Lake Dam can adequately pass approximately 20% of the PMF.

SECTION 6 EVALUATION OF STRUCTURAL STABILITY

From visual observations the general stability of the dam spillway appears to be adequate. However, two factors must be considered. The first is the nature of the clay and sand foundation of the spillway. The stability of the spillway depends on the efficiency of the timber cut off below the spillway. No previous operating record for a normal flood can ensure satisfactory performance during an extreme flood. The second is the maximum flood the structures can withstand. An extreme flood would pass over the crest of the dam, i.e. over the road. This could result in erosion of the downstream slope which could undermine the downstream portion of the spillway abutments.

Indian Lake Dam is located in Seismic Zone 1 of the Seismic Zone Map of Contiguous States. The degree of stability of the dam and appurtenances are assumed to be within conventional safety margins and to present no hazard from earthquakes. If, however, there is loose sand below the dam, or, the Seismic Zone rating is seriously increased in the future, or data becomes available to indicate it may be increased, further study with respect to seismic stability may be necessary.

SECTION 7 ASSESSMENT, RECOMMENDATION, REMEDIAL MEASURES

7.1 Assessment

The available information on Indian Lake Dam is not sufficient to draw a conclusion concerning the actual degree of stability. However, conditions appear satisfactory. We are concerned about the possibility of seepage under the spillway and erosion of the downstream toe of the spillway during an extreme flood.

Because Indian Lake receives the flow from Lake Estling, some maintenance work on the abutments of the arch spillway of Estling Lake Dam is necessary to ensure its satisfactory performance under extreme flood conditions.

7.2 Recommendations/Remedial Measures

We recommend the following remedial measures;

1. Determine the condition and effectiveness of the timber sheet pipe cutoff along the upstream face of the spillway. This will require at least one boring and possibly a test pit to determine the nature of the spillway foundation materials and the condition of the connection between the cutoff wall and spillway. Piezometers could be installed upstream and downstream and the spillway and monitored during a time when the lake is normally drawn down. This should be done very soon.

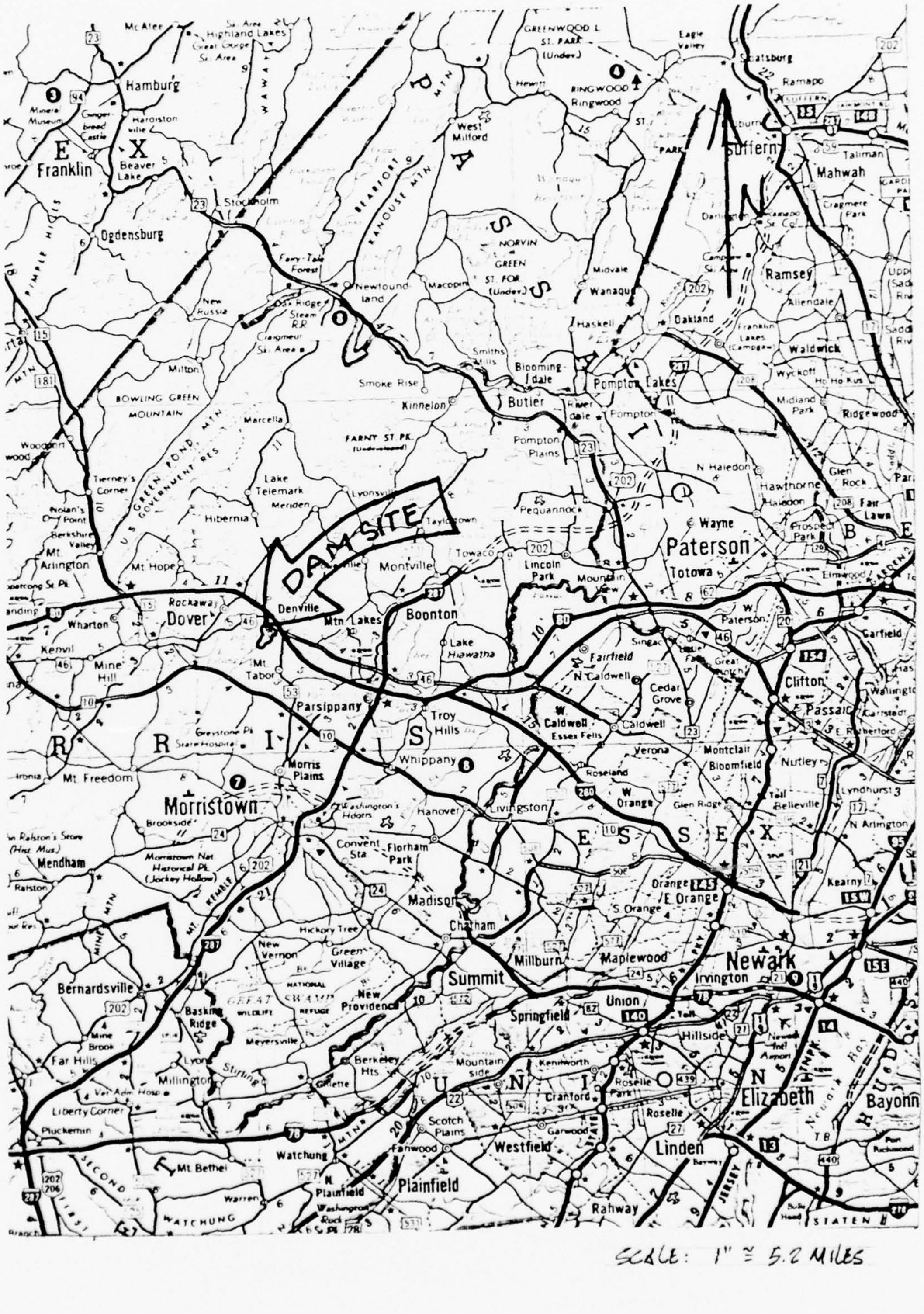
2. Provide erosion protection for the downstream abutments of the spillway to prevent loss of embankment in the event of overtopping of the dam. This should be done very soon.

3. Make necessary repairs to the Lake Estling spillway to ensure its satisfactory performance during extreme floods. This should be done very soon.

4. Repair concrete support to the floor stand gate operator and the bulkhead. This should be done in the near future.

5. Evaluate alternative locations of the pipe between the spillway side walls. This should be done very soon.

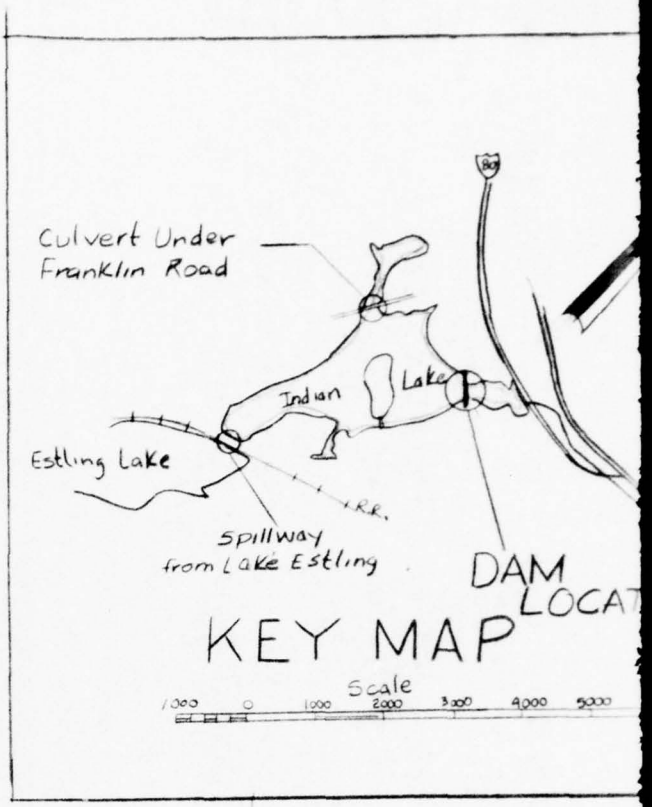
6. The spillway capacity as determined by CE screening criteria is seriously inadequate. We estimate the dam can adequately pass only 20% of the PMF. The capacity of the spillway and SDF should be determined using more precise and sophisticated methods and procedures. A more extensive topographic survey of the dam and vicinity should be made. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done soon.



SCALE: 1" ≅ 5.2 MILES

REGIONAL VICINITY MAP
INDIAN LAKE DAM

Fig 1


Culvert Under
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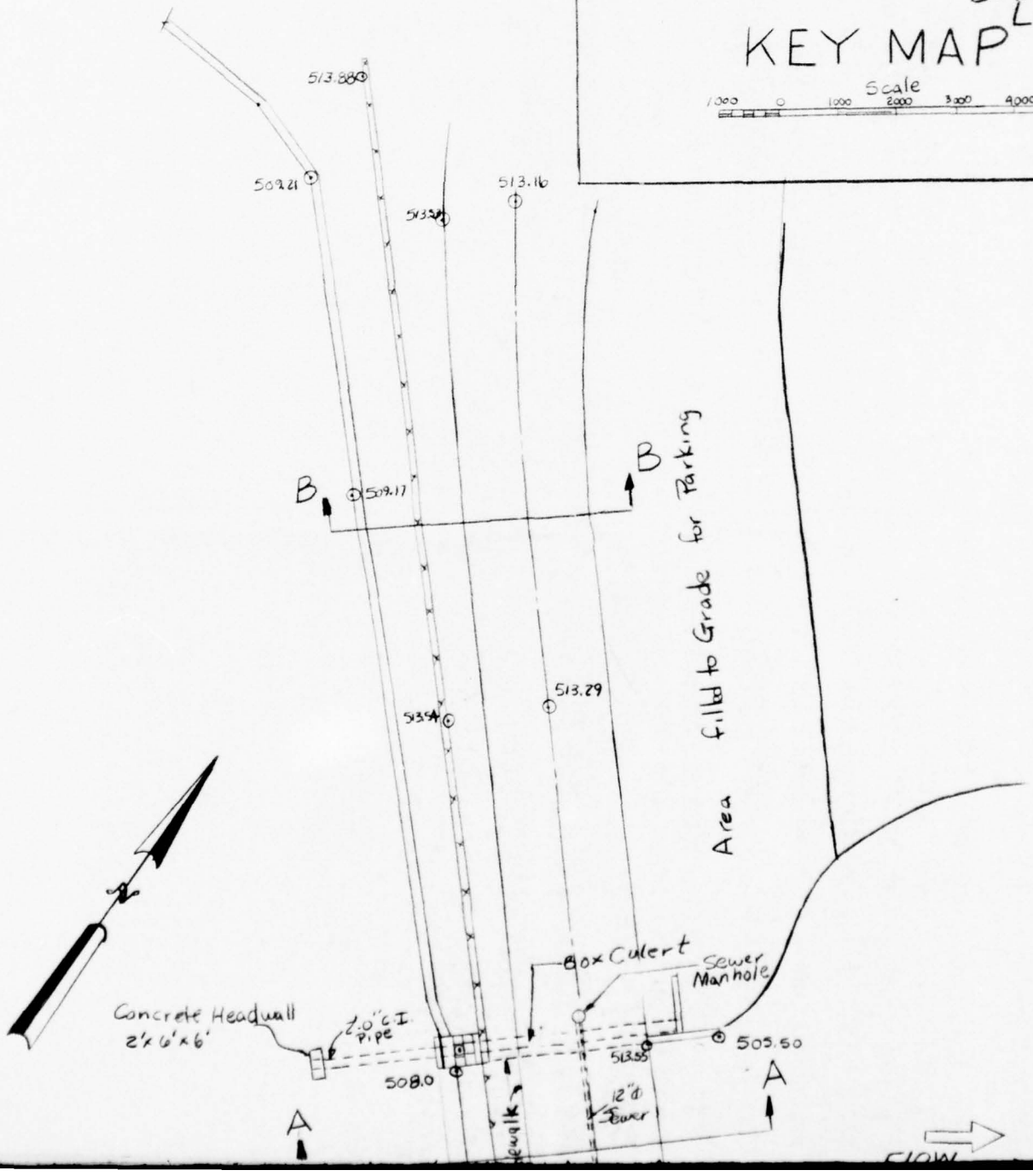
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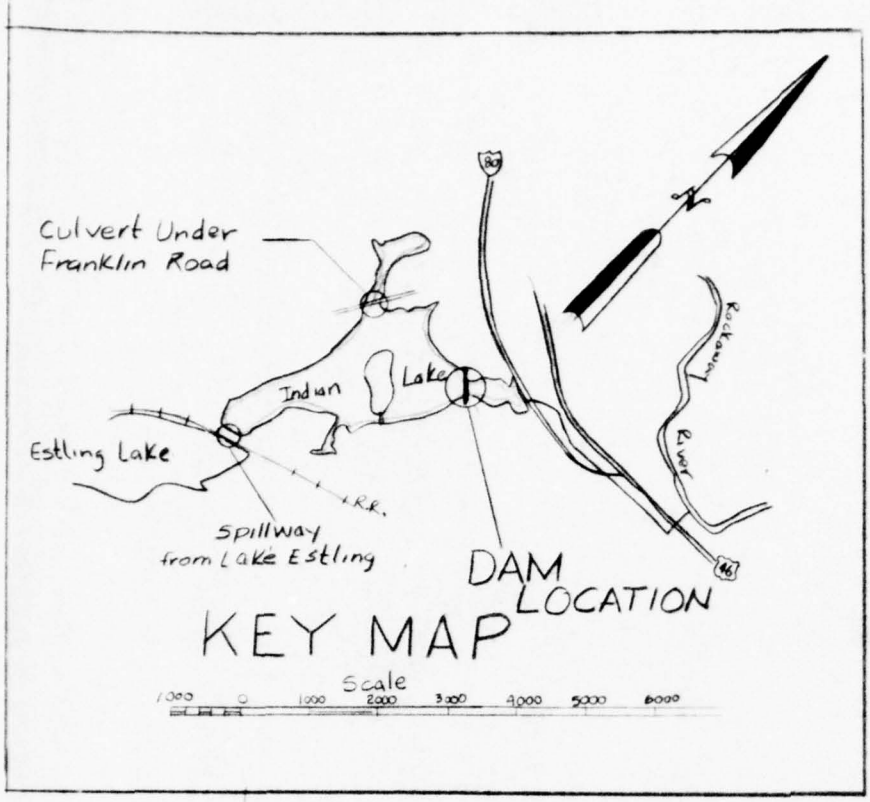
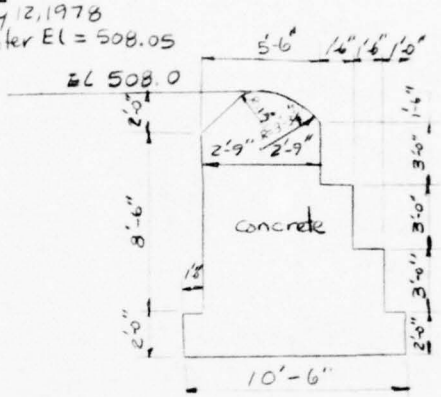
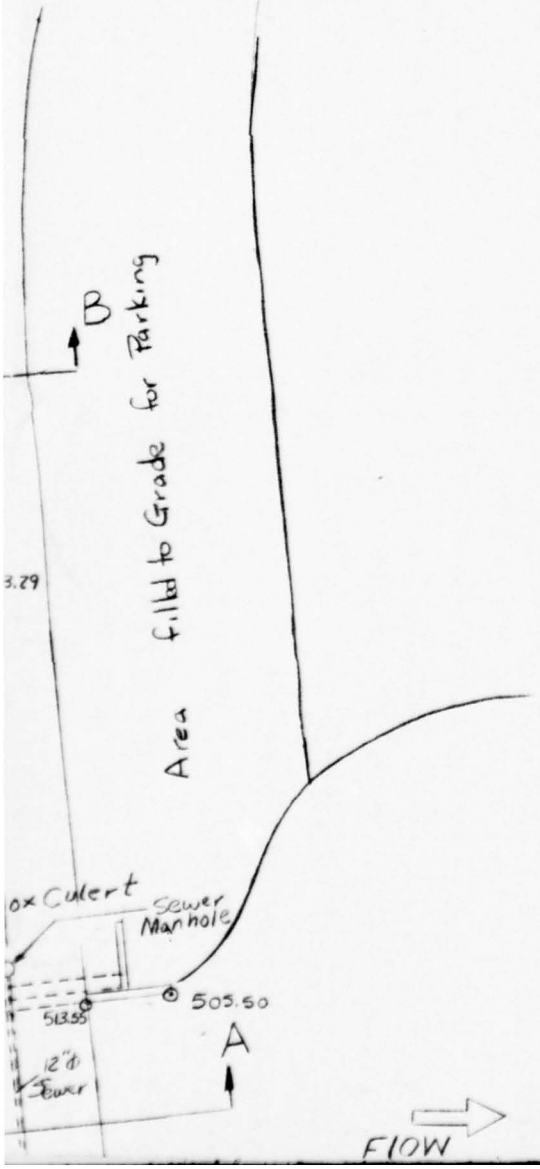


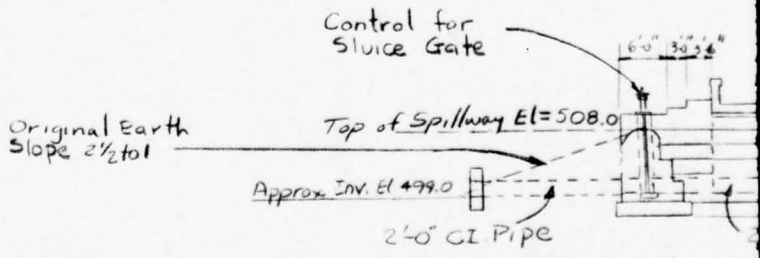
CORE WALL
on each side of spillway 8'-0" long

Note
July 12, 1978
water El = 508.05



CROSS SECTION OF SPILLWAY





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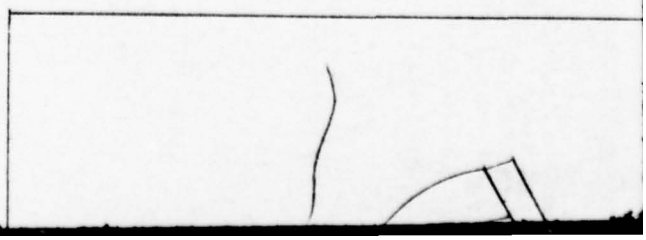
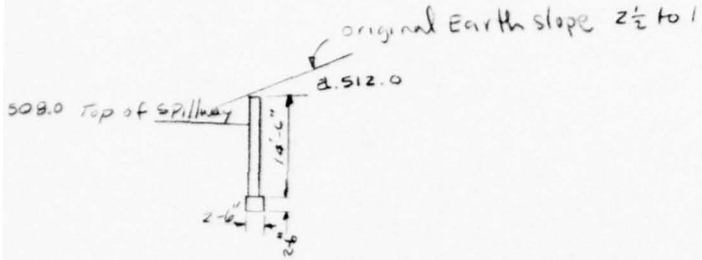
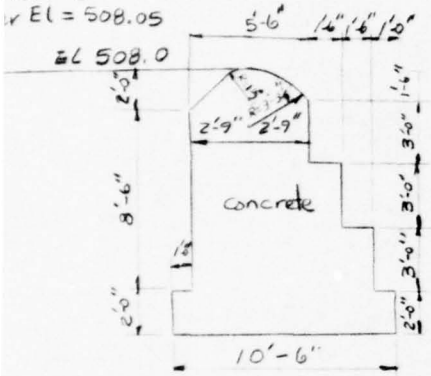
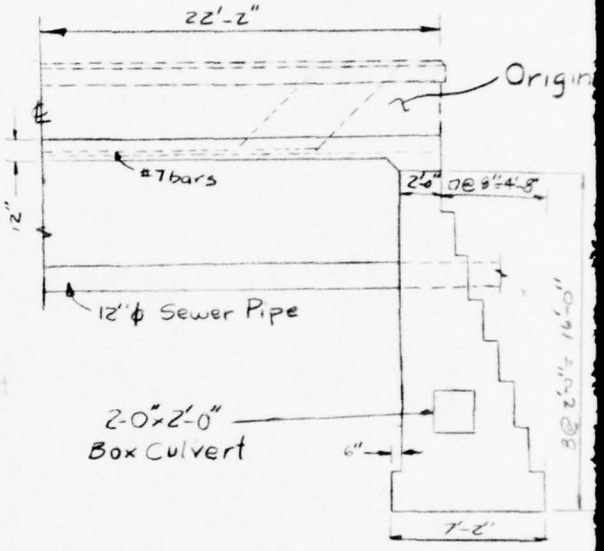




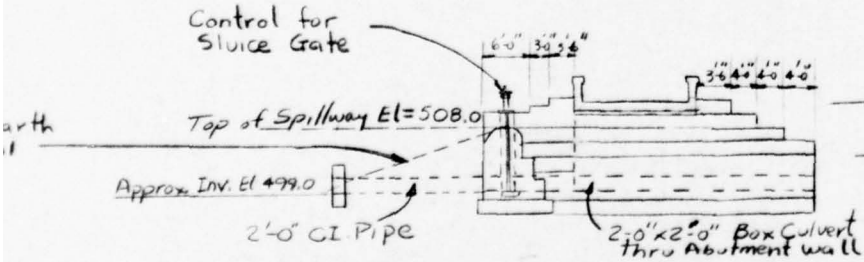
CORE WALL
on each side of spillway 8'-0" long



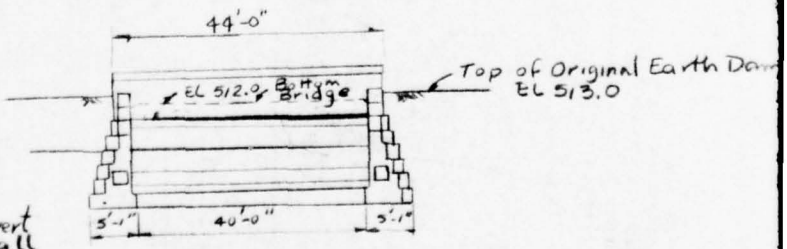
SECTION OF SPILLWAY



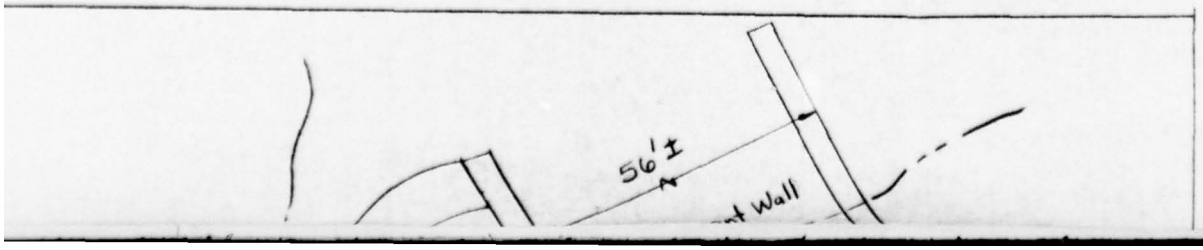
HALF LONGIT. SECTION B

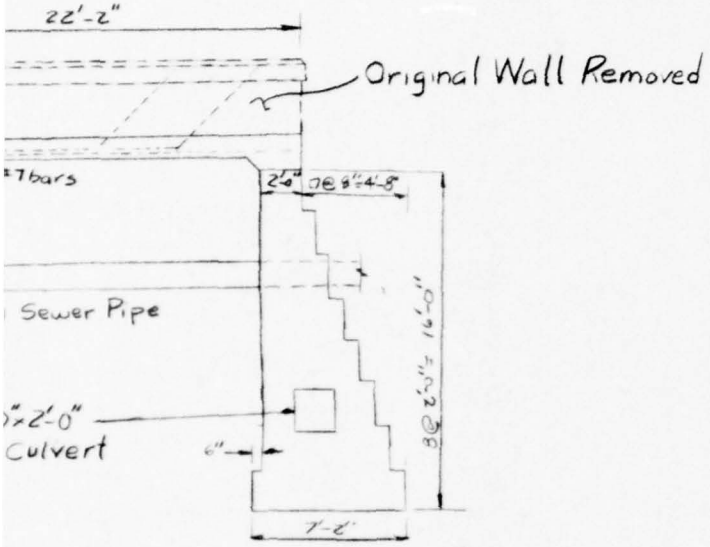


NAL SECTION A-A ALONG SPILLWAY

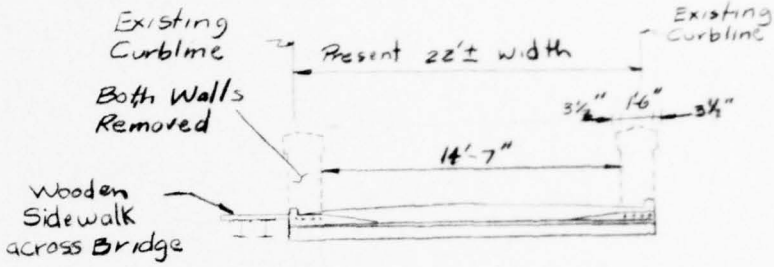


ELEVATION

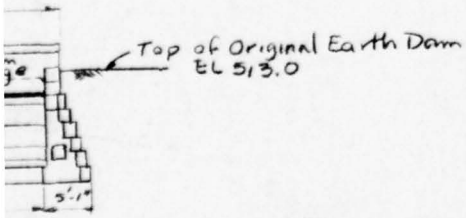




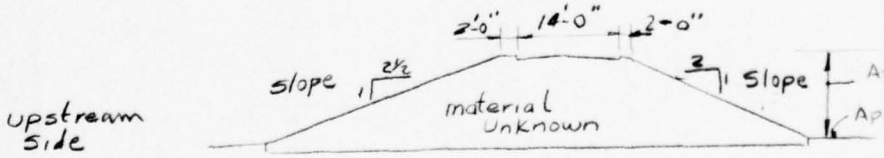
NGIT. SECTION BRIDGE



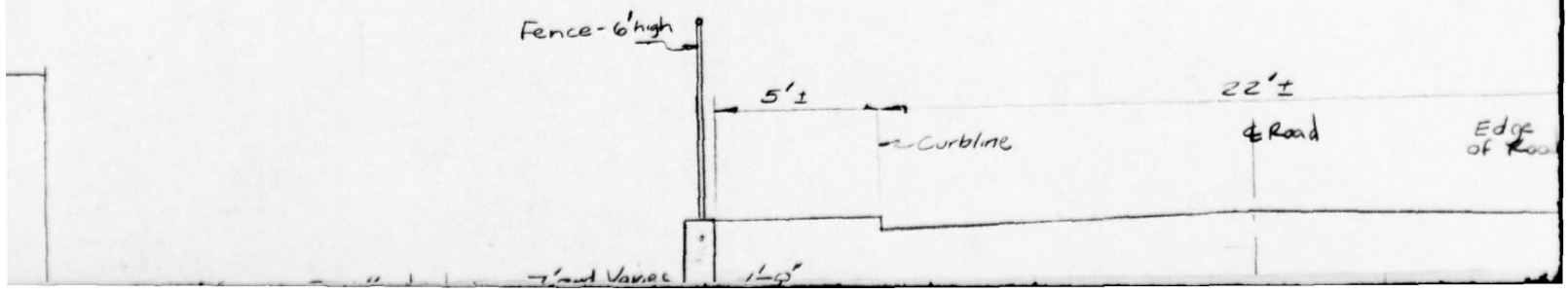
BRIDGE CROSS SECTION

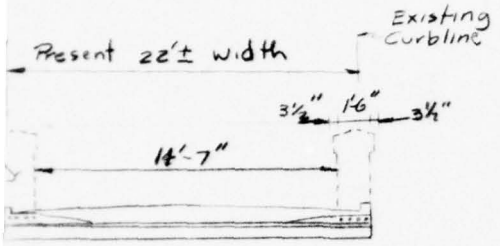


ION

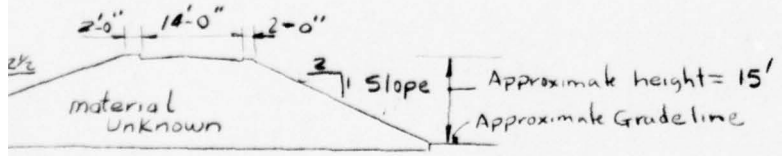


ORIGINAL EARTH DAM CROSS SECTIO

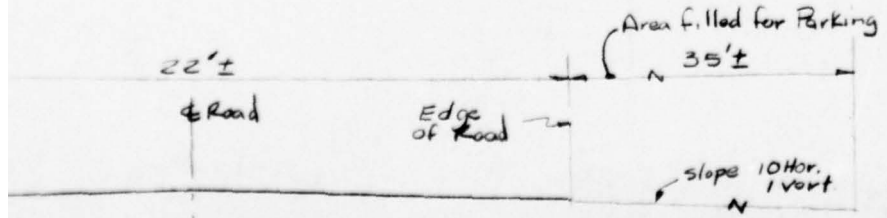


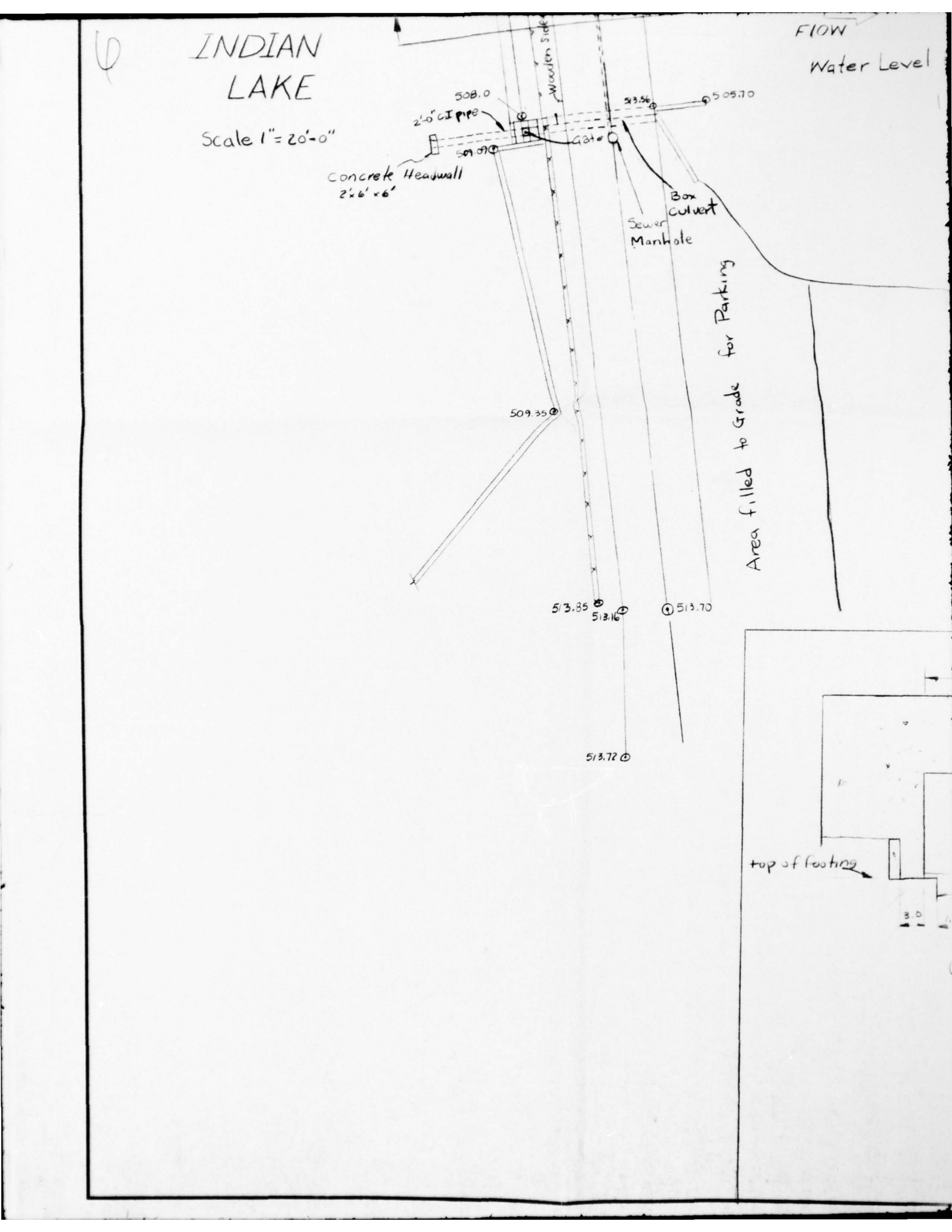


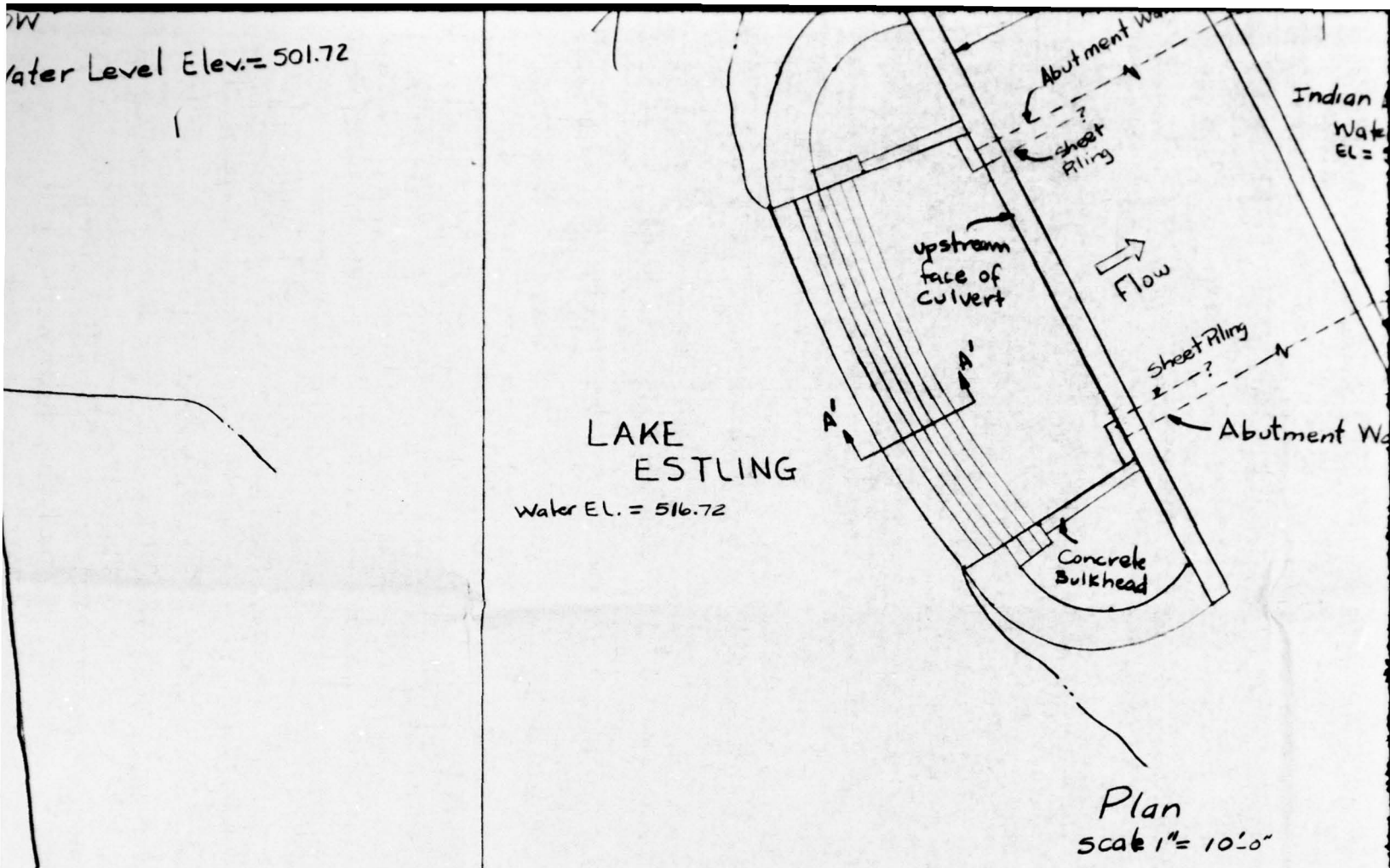
RIDGE CROSS SECTION



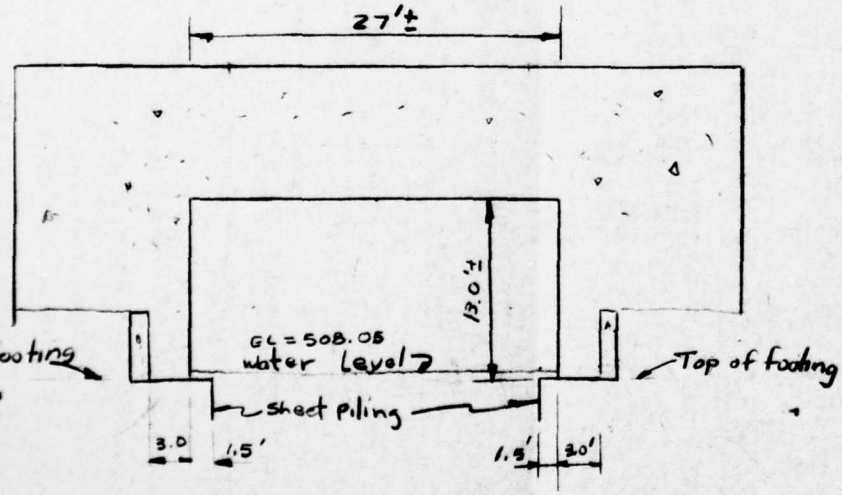
EARTH DAM CROSS SECTION



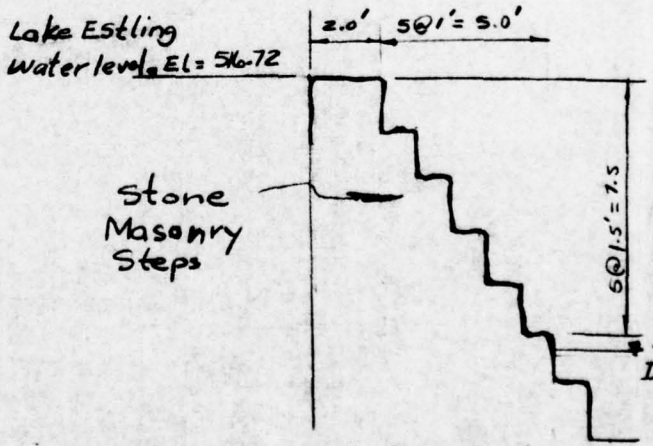

INDIAN LAKE
Scale 1" = 20'-0"
FLOW
Water Level
Wooden Side
508.0
2'-0" CI pipe
509.09
Concrete Headwall
2'x6'x6'
Gate
513.56
505.70
Box Culvert
Sewer Manhole
Area filled to Grade for Parking
509.35
513.35
513.16
513.70
513.72
top of footing
3.0



Plan
scale 1"= 10'-0"

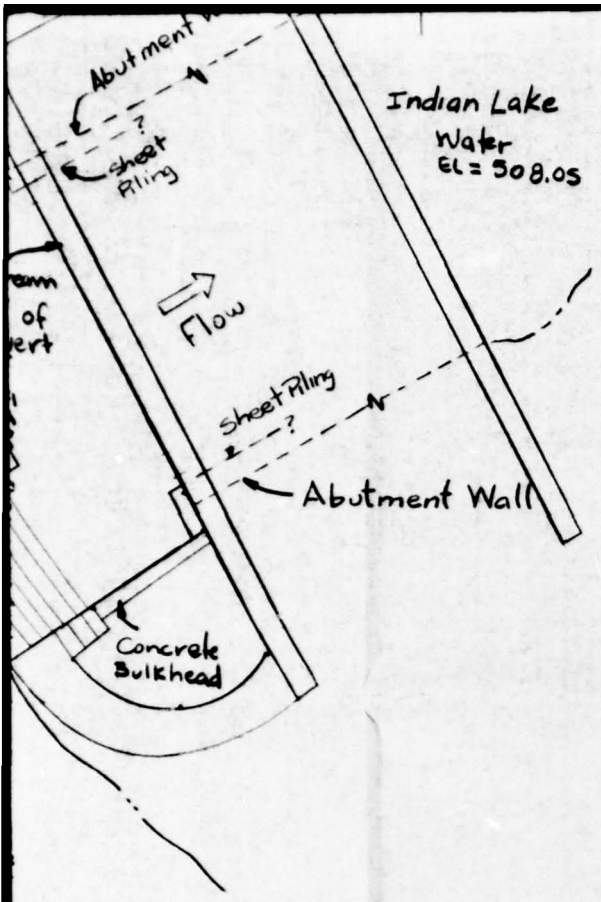


Upstream face of Culvert
Scale 1"= 10'-0"

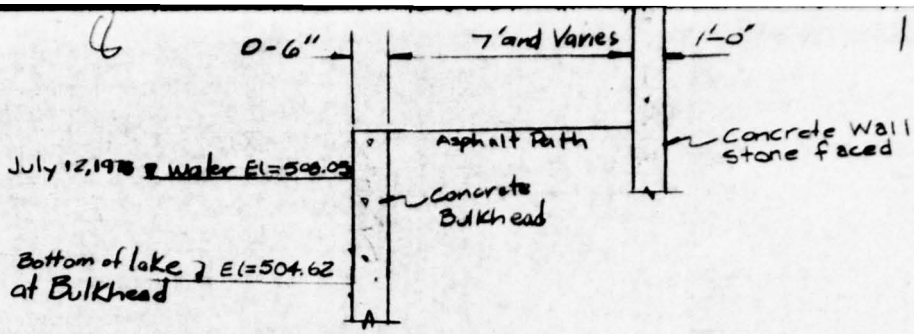


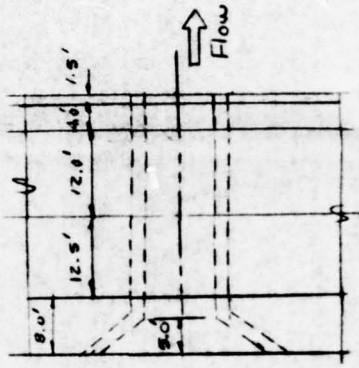
Section A'-A'
Spillway
Scale 1"=4'-0"

SPILLWAY FROM LAKE ESTLING INTO INDIAN LAKE

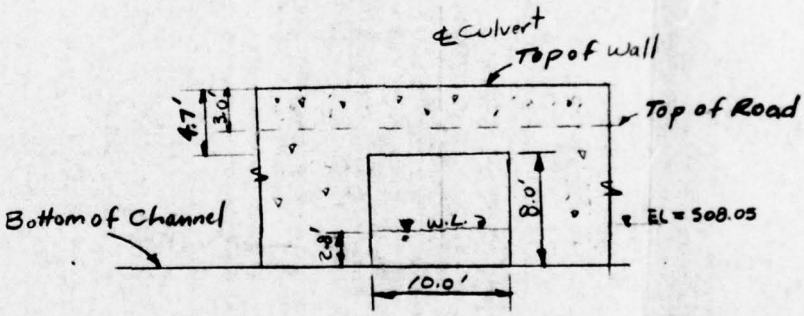


Plan
Scale 1" = 10'-0"

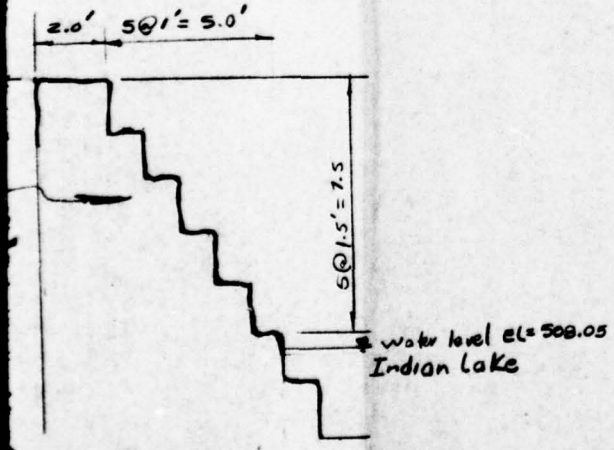




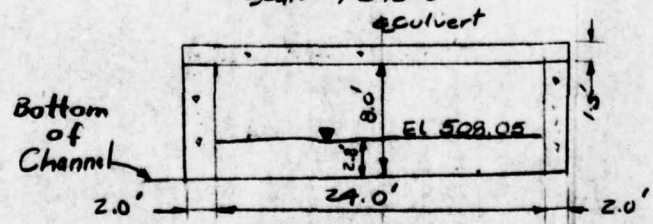
Plan
Scale 1" = 20'-0"



Downstream face of Culvert
Scale 1" = 10'-0"



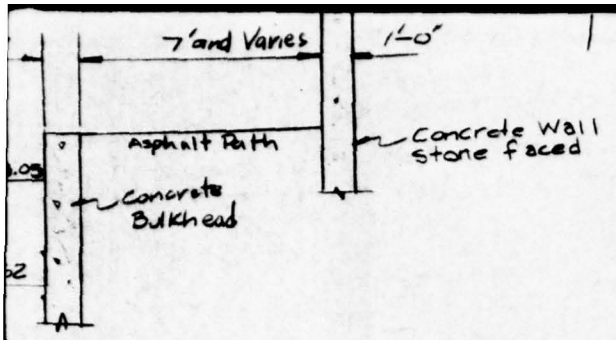
Section A'-A'
Spillway
Scale 1" = 4'-0"



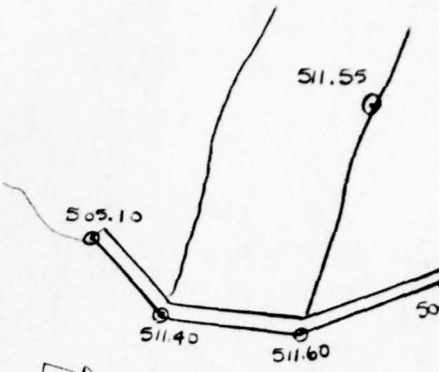
Upstream face of Culvert
Scale 1" = 10'-0"

CULVERT UNDER FRANKLIN ROAD

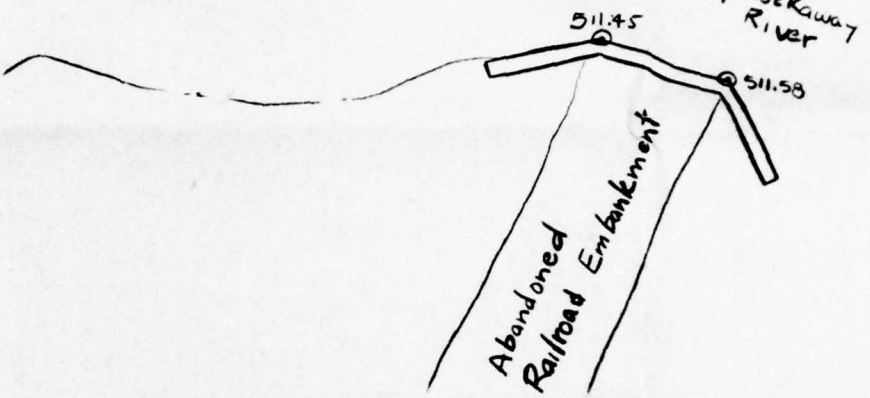
INDIAN LAKE



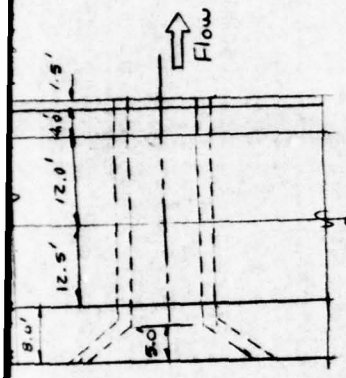
SECTION B-B
Scale 1"=4'-0"



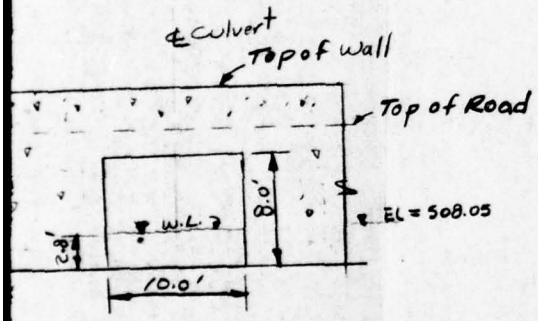
Flow to outlet & Rockaway River



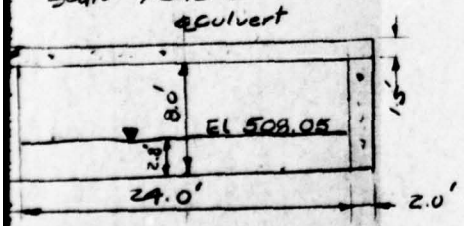
OUTLET OF STILLING BASIN
Scale 1"=20'-0"



Plan
Scale 1"=20'-0"



Downstream face of Culvert
Scale 1"=10'-0"

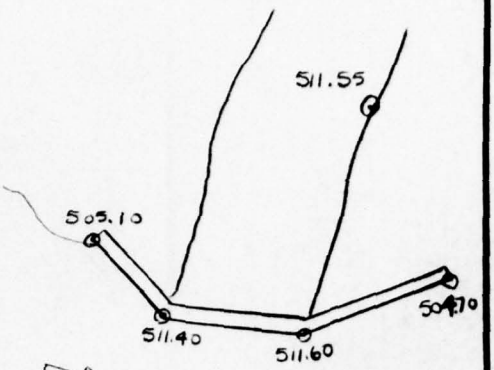


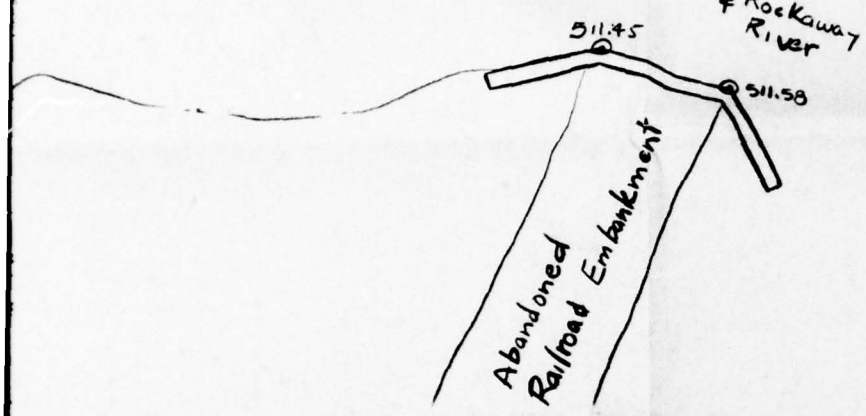
upstream face of Culvert
scale 1"=10'-0"

ERT UNDER FRANKLIN ROAD

Note: The Elevations shown were obtained using A surveyor's transit and level and USGS Map for BOONTON QUADRANGLE. The reference elevation of 520.0 at the N.E. Corner of the bathhouse was used and later adjusted to the as built drawings of the spillway's recorded elevation of 508.0.

ECTION B-B
Scale 1"=4'-0"





OUTLET OF STILLING BASIN
Scale 1"=20'-0"

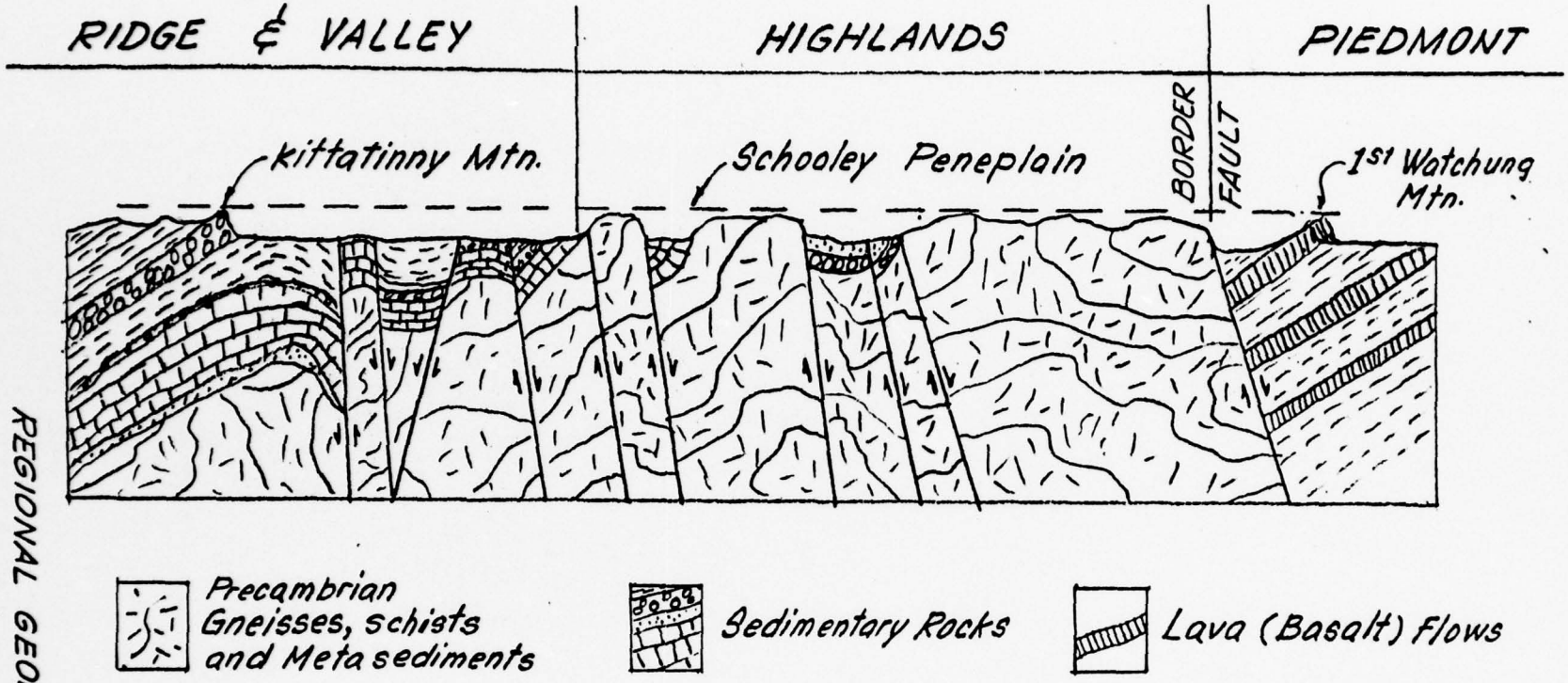
Note: The Elevations shown were obtained using a surveyor's transit and level and USGS Map for BOONTON QUADRANGLE. The reference elevation of 520.0 at the N.E. Corner of the bathhouse was used and later adjusted to the as built drawings of the spillway's recorded elevation of 508.0.

DATE	DESCRIPTION	NO.
REVISIONS		

PROJECT
PHASE I
INSPECTION & EVALUATION
of
NEW JERSEY DAMS

DRAWING TITLE
INDIAN LAKE DAM
JULY 1978
FED. ID. No. NJ.00167 N.J. No. 34

JOB NO. J783	DRAWING NO.
DATE 5 July 1978	FIG. 2
SCALE as noted	
DRN. BY JC	
CHKD. BY D.J.L.	OF SHEETS



Schematic Cross-section of New Jersey Highlands Physiographic Province (After Wolfe, 1977)

REGIONAL GEOLOGIC FEATURES

Fig 3

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

INDIAN LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Indian Lake Dam County Morris State New Jersey Coordinators NJ DEP

Date(s) Inspection 27 June 1978, 5 July 1978, 12 July 1978, 19 July 1978 Weather Sunny Temperature 70-80° F

Pool Elevation at Time of Inspection 508.1 M.S.L. Tailwater at Time of Inspection 501.7 M.S.L.

Inspection Personnel:

D. Leary (27 June & 5 July)
A. Puyo (27 June & 5 July)
C. Campbell (12 July)
D. Lachel (12 July)
G. Bondy (19 July)
Mr. Ray Mitchell - Denville Township Water Dept. (19 July)

D. Leary Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Minor Cracks in Surface of Asphalt road paving	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None Observed	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Good	
RIPRAP FAILURES	None observed crack at top of upstream concrete bulkhead and stones have fallen from stone facing of upper retaining wall above concrete bulkhead at right side of spillway.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good at embankment abutments and at spillway sidewalls	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None observed	
DRAINS	None observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Spillway sidewalls have a 2 ft x 2 ft concrete outlet conduit located in each spillway sidewall. Left sidewall is deteriorated, outlet conduit could not be observed.	
INTAKE STRUCTURE	Reported to be functional, could not be observed. Has two 30 inch gates, one at each spillway sidewall. Both gates appear to be in satisfactory working order.	
OUTLET STRUCTURE	Reported to be functional, could not be observed.	
OUTLET CHANNEL	Stilling pond and Den Brook appeared satisfactory without obstructions.	
EMERGENCY GATE	No emergency gate observed	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appears to be generally in satisfactory condition with weathering of vertical grooves of what appears to be construction joints.	
APPROACH CHANNEL	Appears satisfactory	
DISCHARGE CHANNEL	Appears satisfactory	
BRIDGE AND PIERS	Good condition, however, pipe is below bridge and across spillway and could cause obstruction	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	No signs of slope instability observed. Residential area surrounds Lake. Slopes vary from about 30 hor to 1 vert to 15 hor to 1 vert.	
SEDIMENTATION	There could be considerable sedimentation in Lake because Lake Estling and Shongum feed Indian Lake. However, no measurements were made.	

DOWNSTREAM CHANNEL

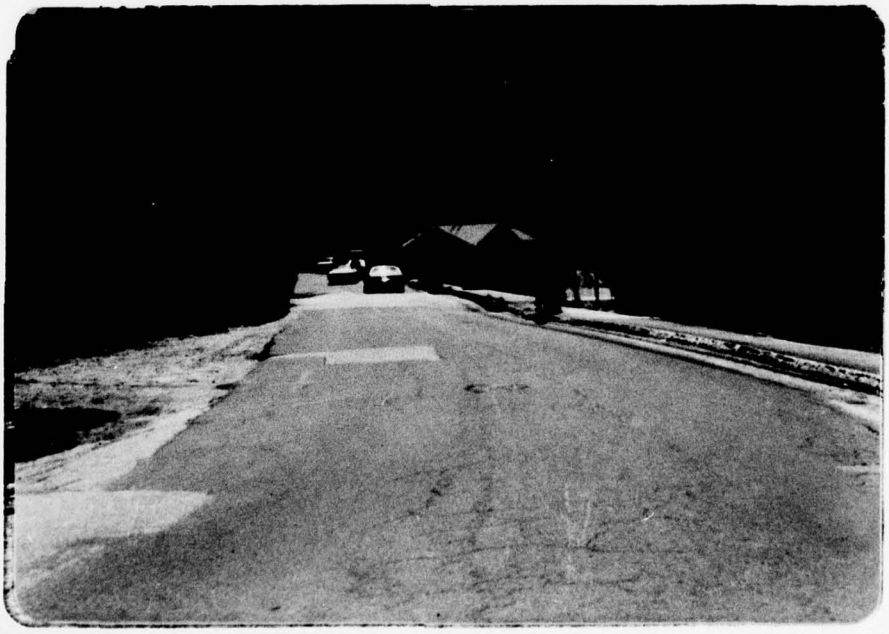
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions or debris observed.	
SLOPES	Appeared relatively flat and stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Nearest City reported to be Denville with population of 11,000 . Routes 80 and 46 are located immediately downstream of dam.	

APPENDIX 2

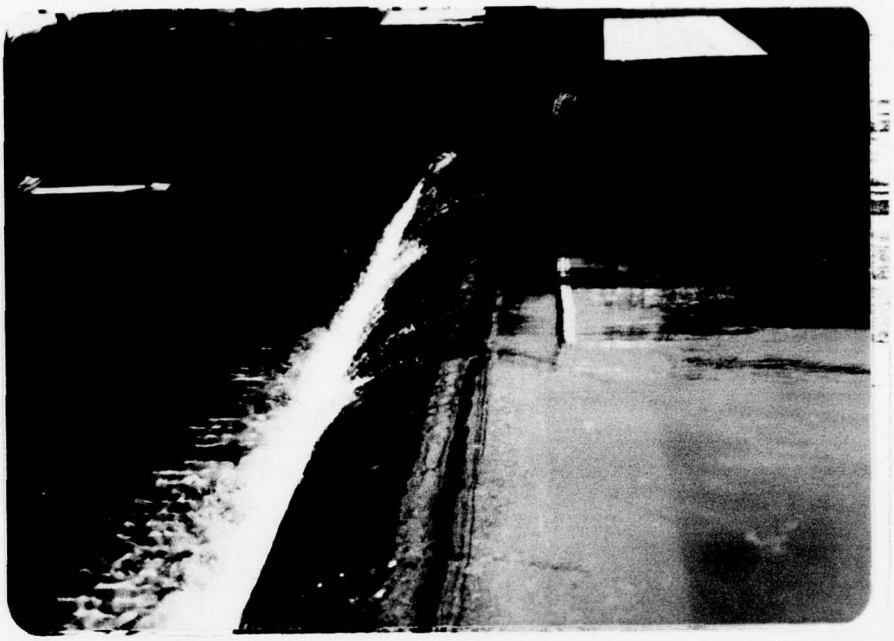
PHOTOGRAPHS

INDIAN LAKE DAM

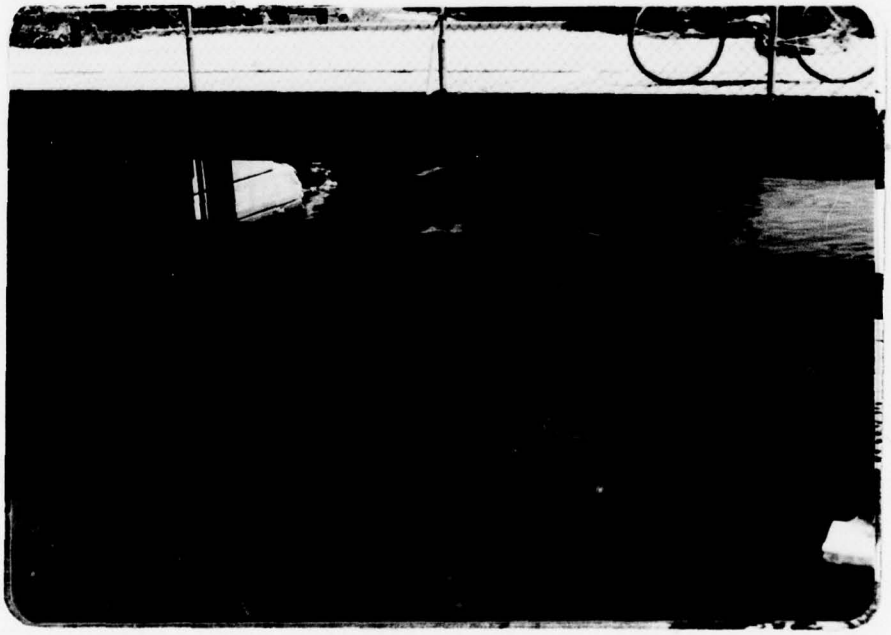
Crest of dam looking Northwest 5 July 1978



Crest of dam looking Southeast 5 July 1978



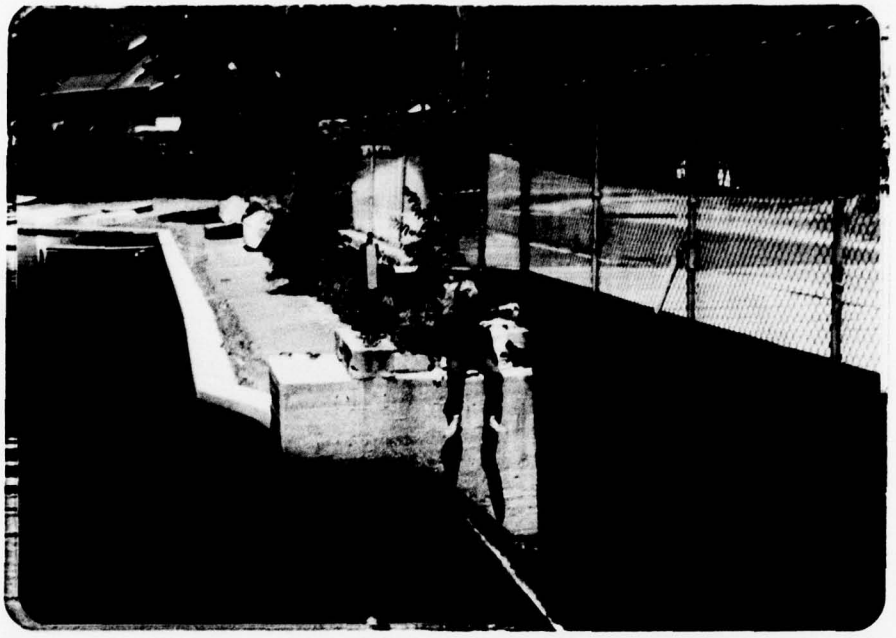
Spillway looking Southeast 5 July 1978



Spillway looking downstream. 5 July 1978
Note steel beam pipe support across spillway.

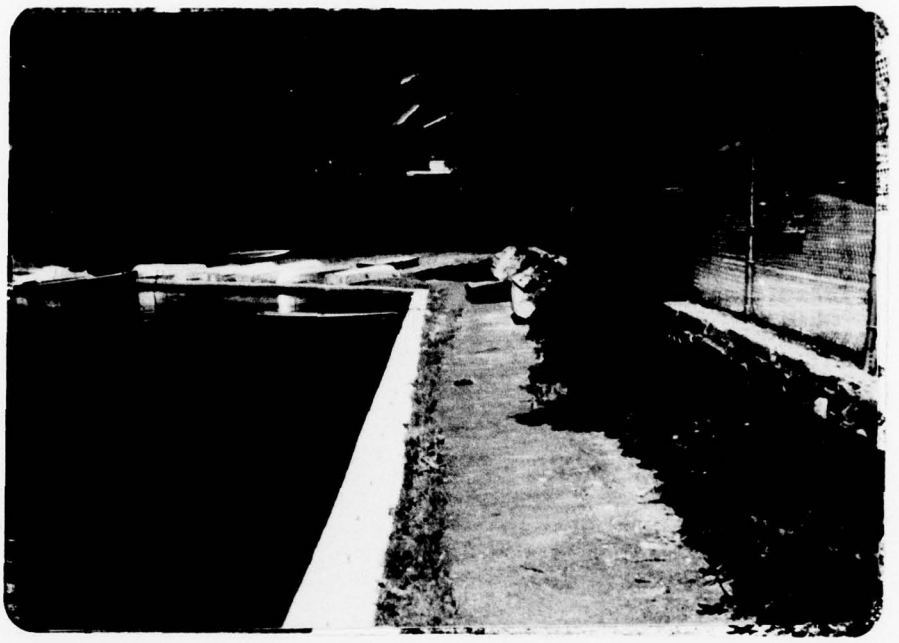
Right sidewall of spillway 5 July 1978

Deterioration of concrete at left downstream sidewall of spillway 5 July 1978



Left spillway sidewall and drawdown control valve — 5 July 1978

Drawdown control valve of upstream end of right sidewall — 5 July 1978

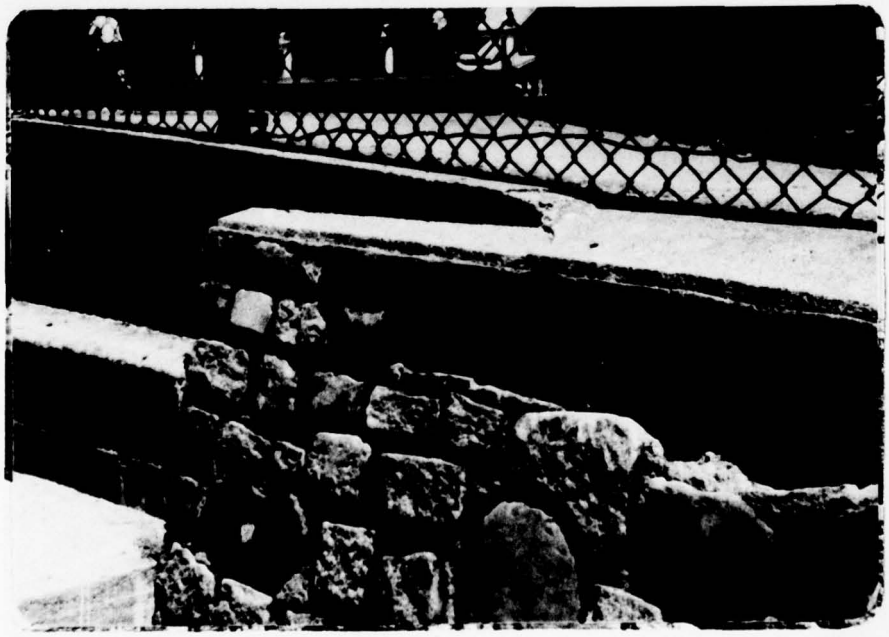


Upstream left embankment 5 July 1978

Upstream right embankment 5 July 1978

INDIAN LAKE DAM

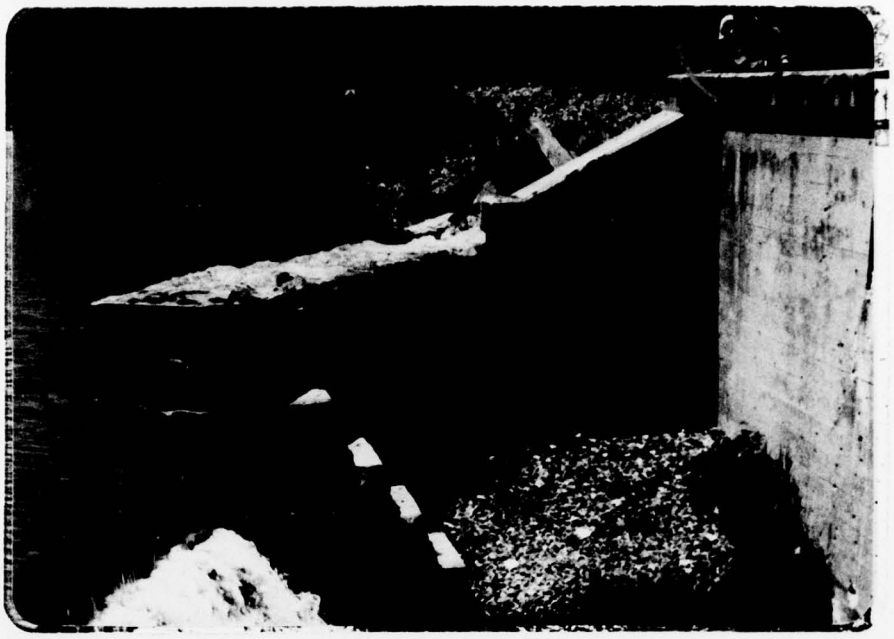
Crack in concrete bulkhead of right upstream section of embankment — 5 July 1978



Deterioration of upstream facing of right embankment — 5 July 1978

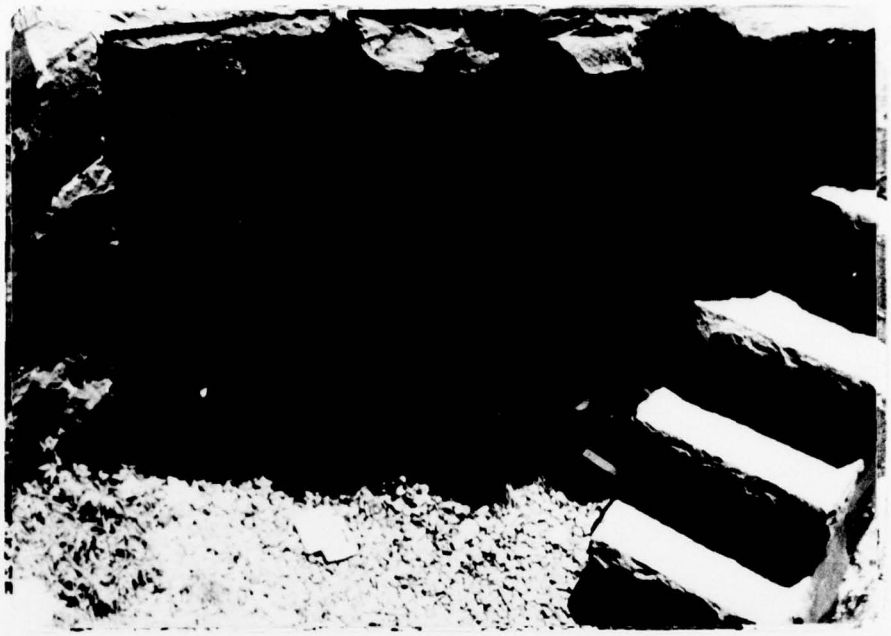
Spillway from Lake Estling into Indian Lake — 5 July 1978

Steel sheet pile around right pier of Lake Estling discharge culvert under railroad — 5 July 1978

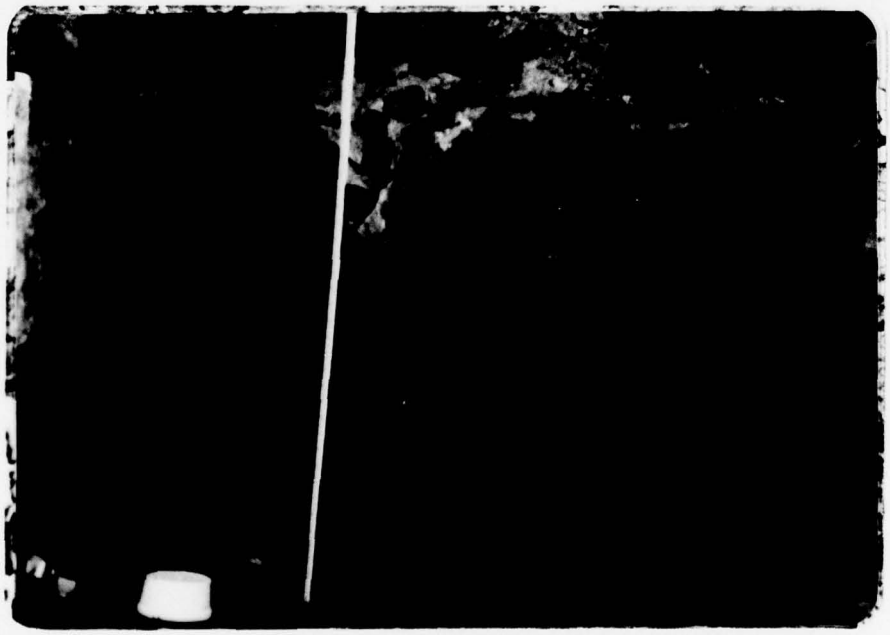


Left abutment of spillway from Lake Estling — 5 July 1978

Deterioration of mortar and leakage at left abutment of spillway from Lake Estling — 5 July 1978

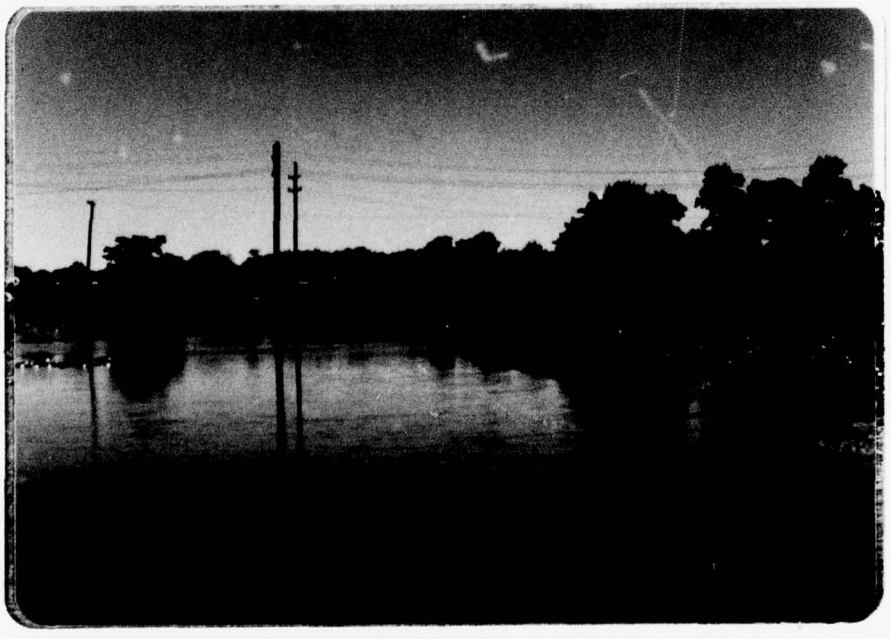


Right abutment of spillway from Lake Estling — 5 July 1978



Deterioration of mortar and leakage of right abutment of spillway from Lake Estling — 5 July 1978

Culvert under Franklin Road 5 July 1978



Stilling basin downstream of Indian Lake spillway looking Southeast 5 July 1978

VISUAL	CONCRE	APPROA	DISCH	BRIDG

APPENDIX 3

HYDROLOGIC COMPUTATIONS

INDIAN LAKE DAM

LANGAN ENGINEERING ASSOCIATES, INC.

HYDROLOGICAL COMPUTATIONS
INDIAN LAKE DAM

Location Morris County

Drainage Area

Indian Lake Subbasin	617 acres	or .96 sq mi
Lake Estling Subbasin	4120 acres	or 6.44 sq mi
Totals	4737	7.40 sq mi

Lake Area

Indian - 88 acres

Estling - 75 acres

Approach

Due to the presence of an adjacent lake within catchment area multiple PMF and routing were performed. The effect of Shongum Lake was not considered and PMF and routing was done for only Lake Estling and Indian Lake

Evaluation Criteria Size - Intermediate
Hazard - High

Spillway Design Flood PMF

Calculate PMP

1. Dam Located in Zone C PMP = 22.5"
2. Adjustment Factors

Duration (hr)	% of 24 hr	Reduction Factor *
0-6	112	0.8 all ours
0-12	123	
0-24	132	
0-48	142	

* P 48 "Small Dams"

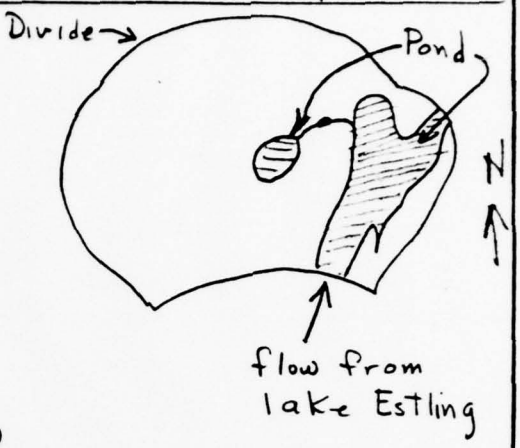
BY JC DATE 7/28/78 Indian Lake JOB NO. J-783

CKD. GED DATE ____ SHEET NO. 1 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

(INDIAN LAKE)

DETERMINE TIME OF CONCENTRATION



Since there is no one defined main channel for the Indian Lake water shed, we will take overland flow to determine Tc

The average slope of the water basin = 3.6%

average Length = 4700

From a site inspection The groundcover is "Forrest with Heavy Ground Litter & Meadow"

A/ From SCS Tech Rel #55

Fig 3-1 vel. = 0.46 fT/sec

$$T_c = \frac{\text{length}}{\text{velocity}} = \frac{4700}{0.46(3600)} = 2.8 \text{ hours}$$

B/ Determine Tc by SCS #55 Fig 3-3

Take l = Greatest flow length

= 6500 feet ; CN = 60

∴ Lag Time = 1.35 HR

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$$T_c = \frac{1.35}{0.6} = 2.25 \text{ HOURS}$$

Take $\boxed{T_c = 2.3 \text{ HOURS}}$

DETERMINE TIME TO PEAK

$$T_p = \frac{D}{2} + 0.6\,T_c$$

Take D = 30 min

$$\therefore T_p = \frac{.5}{2} + 0.6(2.3) = 1.63 \text{ HOURS}$$

$\therefore$ Take $\boxed{T_p = 1.6 \text{ HOURS}}$

UNIT HYDROGRAPH

Take q_p from SCS formula

$$q_p = \frac{484\,A}{T_p} = \frac{484\,(0.96)}{1.6} = 290 \text{ cfs}$$

A curvilinear hydrograph may be constructed from the values of q_p and T_p by using ratios tabulated in "Design of Small Dams" pg 74
Take the time increment = D

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HOURS	T/T_P	q/q_P	UNIT HYDROGRAPH q (CFS)
.5	0.31	0.16	46
1.0	0.63	0.61	177
1.5	0.94	0.98	284
2.0	1.25	0.88	255
2.5	1.56	0.60	174
3.0	1.88	0.40	116
3.5	2.19	0.24	70
4.0	2.50	0.16	46
4.5	2.81	0.097	28
5.0	3.13	0.06	17
5.5	3.44	0.04	12
6.0	3.75	0.02	6
6.5	4.07	0.017	5
7.0	4.38	0.010	3

$\Sigma q = 1227$ CFS

Area Under Unit Graph $= \dfrac{1227(.5)(3600)(12)}{617(43560)} = 0.99$ in

Since the outflow from Lake Estling discharges directly into Indian Lake the hydrologic characteristic of Lake Estling will be determined

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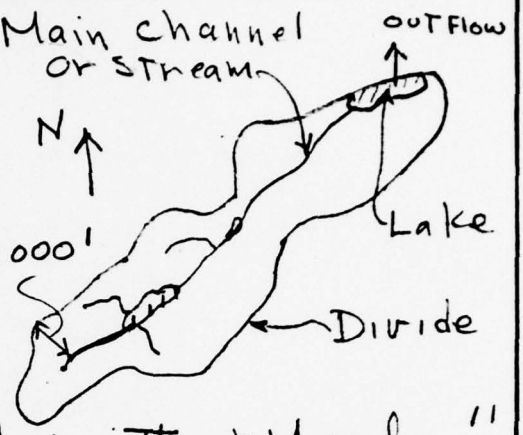
CKED DATE 8/30 SHEET NO. 4 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

(LAKE ESTLING)

DETERMINE TIME OF CONCENTRATION

There is a stream running through the Estling water shed



From inspection of air photos the ground cover is "Forest with heavy Ground Litter & Meadow"

CN = 60

The stream has irregular side slopes and bottom & the section is filled with large growth ∴ Take Manning n = 0.06

The approximate cross section

Slope of the Stream

$$= \frac{800 - 516}{24{,}000}$$

$$= 0.0118$$

The slope of the south portion of the water shed is ≅ 6.4%

From SCS Tech Rel #55

BY JC DATE 8/19 Indian JOB NO. J-783

CKED DATE 8/30 SHEET NO. 5 OF 25

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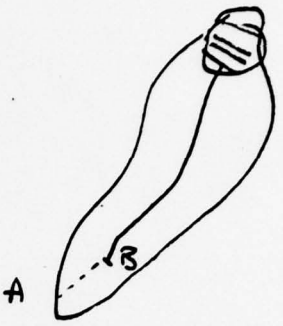
A overland flow time

Fig 3-1 velocity = .64 ft/sec



$$T_{AB} = \frac{5000}{0.64\,(3600)} = 2.17 \text{ hr}$$

Stream Flow

Estimated velocity at in-stream 6 fps

$$T_{BC} = \frac{24000}{6\,(3600)} = 1.11 \text{ hrs}$$

$$T_C = T_{AB} + T_{BC} = 2.17 + 1.1 = \underline{\underline{3.22}}$$

E

BY JC DATE ____ Indian JOB NO. J-783

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LANGAN ENGINEERING ASSOCIATES, INC.

B Determine Tc by Fig 3.3 Tech. Rel #55

Avg slope = 3 %

$\ell = 20{,}000'$

∴ Lag Time = 3.5 hr

$\therefore T_c = \frac{3.5}{0.6} = \underline{5.8 \text{ hr}}$

Take **Tc = 3.2 Hours**

DETERMINE TIME OF PEAK

$T_P = \frac{D}{2} + 0.6\,T_c$

Take $D \simeq 0.2\,T_c$ & $0.3\,T_c$

∴ D = .8 hr

$T_P = \frac{0.8}{2} + 0.6(3.2) = 2.32$ hr

BY JC DATE 8/19 Indian JOB NO. J-783

CKD [illegible] DATE 8/30 SHEET NO. 7 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Take $T_p = 2.5$ HOURS

UNIT HYDROGRAPH

Take q_p from SCS formula

$$q_p = \frac{484A}{T_p} = \frac{484\,(6.44)}{2.5} = 1210 \text{ cfs}$$

A curvilinear hydrograph may be constructed from the values of q_p & T_p by using SCS ratio's,

HOURS D	T/T_p	q/q_p	UNIT HYDROGRAPH q_b (cfs)
0.5	.20	.08	97
1.0	.40	.32	387
1.5	.60	.60	726
2.0	.80	.90	1089
2.5	1.0	1.0	1210
3.0	1.2	.92	1113
3.5	1.4	.78	944
4.0	1.6	.60	726
4.5	1.8	.42	508
5.0	2.0	.32	387
5.5	2.2	.24	290
6.0	2.4	.17	205
6.5	2.6	.14	169
7.0	2.8	.10	121
7.5	3.0	.07	85
8.0	3.2	.055	67
8.5	3.4	.04	48
9.0	3.6	.03	36
9.5	3.8	.02	24
10.0	4.0	.018	22

$\Sigma = 8205$ cfs

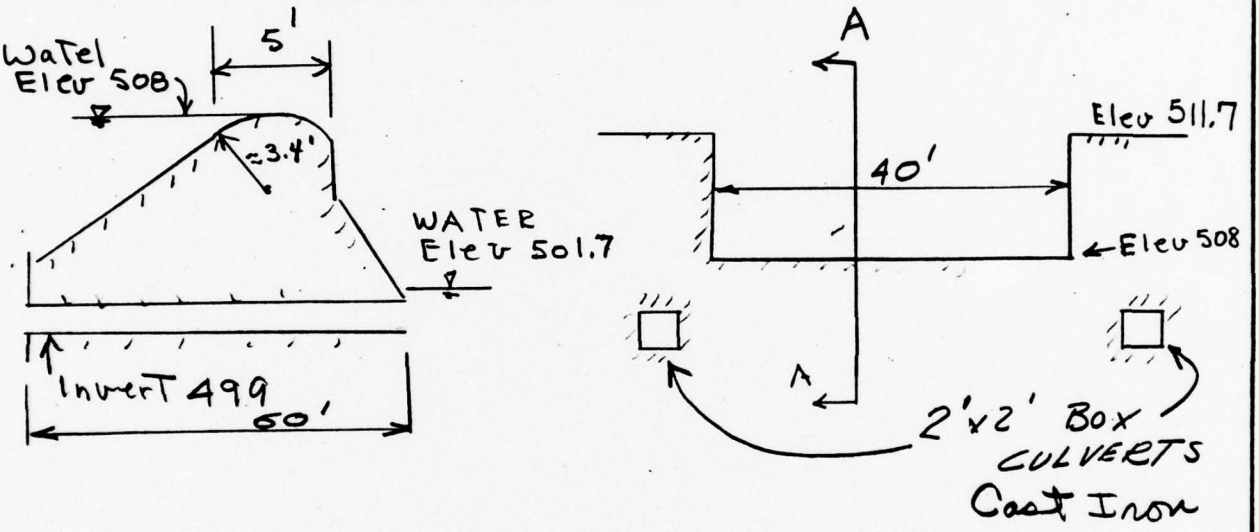
BY JC DATE 8/19 Indian JOB NO. J-783

CKD DATE 8/30 SHEET NO. 8 OF 25

Area Under Unit Graph $= \frac{8205\,(.5)(3600)(12)}{(4120)\,43560} = .99$ in

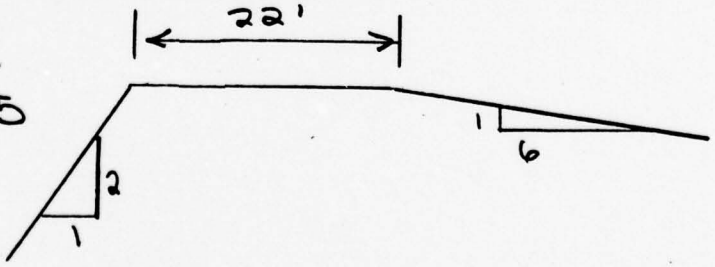
SPILL WAY CAPACITY

Indian lake



Typical Reservoir Cross-section

Top of Reservoir Low point = 513.5



Take equation of the weir

$$Q = C L H^{3/2}$$

BY JC DATE 8/22 Indian JOB NO. J-783

CKD. DATE 8/30 SHEET NO. 9 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

The coefficients C will be determined from "Handbook of Hydraulics" King & Brater, chapter 5

Spillway: Elev Crest 508.0

Cavg = 3.3 pg 5.50 Table 5-12

L = 40 feet

Reservoir

Cavg = 3.0 pg 5-49, Table 5-9

BY JC DATE 8/22 Indian JOB NO. J-783

CKD [illegible] DATE 8/30 SHEET NO. 10 OF 25

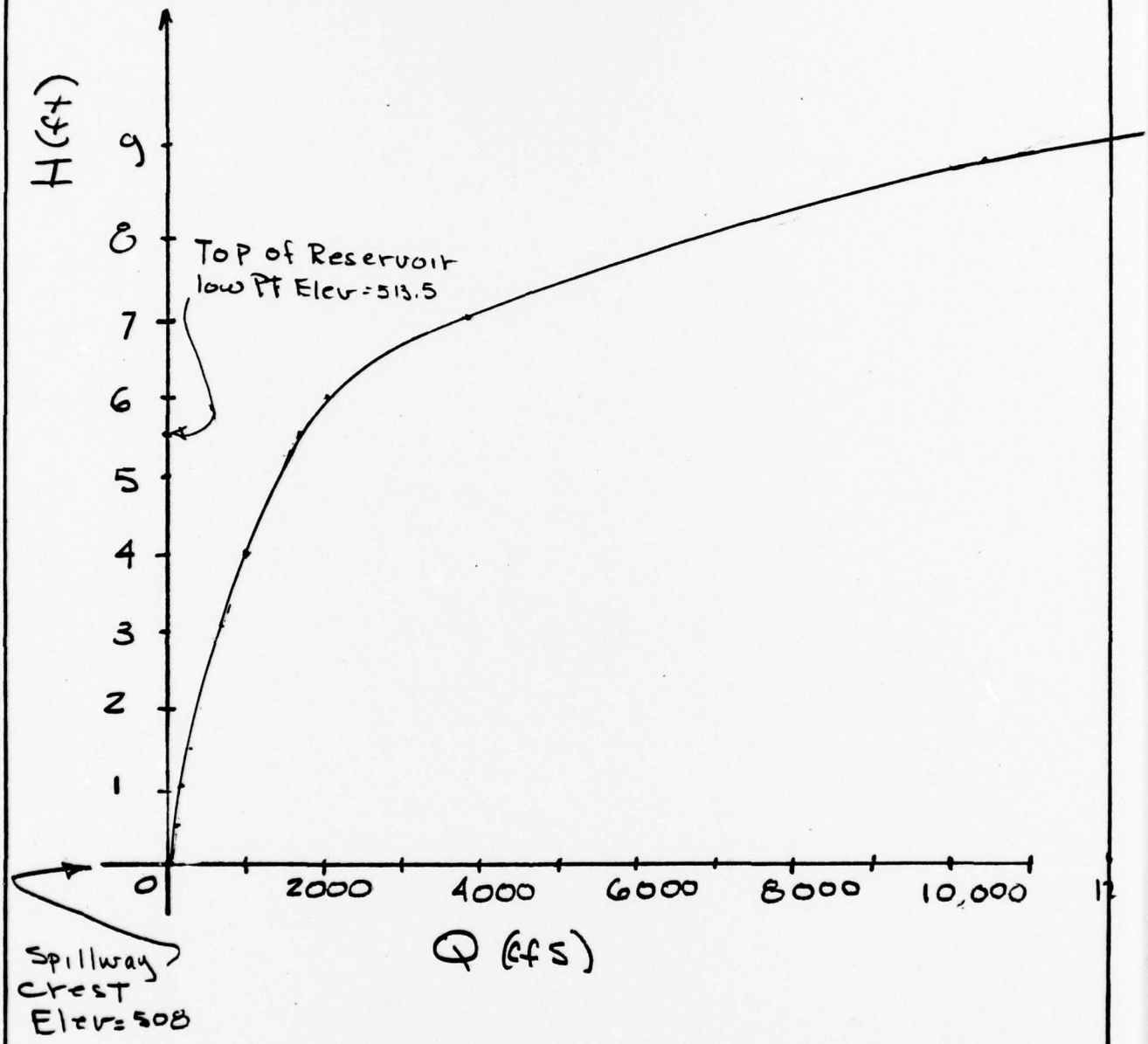
LANGAN ENGINEERING ASSOCIATES, INC.

Elev (ft)	Spillway H (ft)	Spillway Q_s (CFS)	Reservoir H ft	Reservoir L ft	Reservoir Q_R (CFS)	Q TOTAL (CFS) $Q_s + Q_R$
508	0	0				0
508.5	.5	47				47
509.0	1.0	132				132
509.5	1.5	242				242
510.0	2	373				373
511	3	686				686
512	4	1056				1056
513.5	5.5	1702	0			1702
514	6	1940	.5	100	106	2046
515	7	2445	1.5	250	1378	3823
517	9	3564	3.5	350	6875	10439

BY JC DATE 8/22 Indian JOB NO. J-783

CKD CED DATE 8/30 SHEET NO. 11 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.



Spillway Capacity Curve Indian lake

BY JC DATE 8/22 Indian JOB NO. J-783

CKD JED DATE 8/30 SHEET NO. 12 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Reservoir Storage Capacity (Indian)

Assume a linear distribution for the increase in the area with elevation. Start at a zero storage at the crest of the spillway

Lake area = 87.6 Acres, Elev 508

Area Elev 520 = 176.3 Acres

∴ Area increase per foot of Elev.

$$= \frac{(176.3 - 87.6)}{520 - 508} = 7.4 \text{ Acres}$$

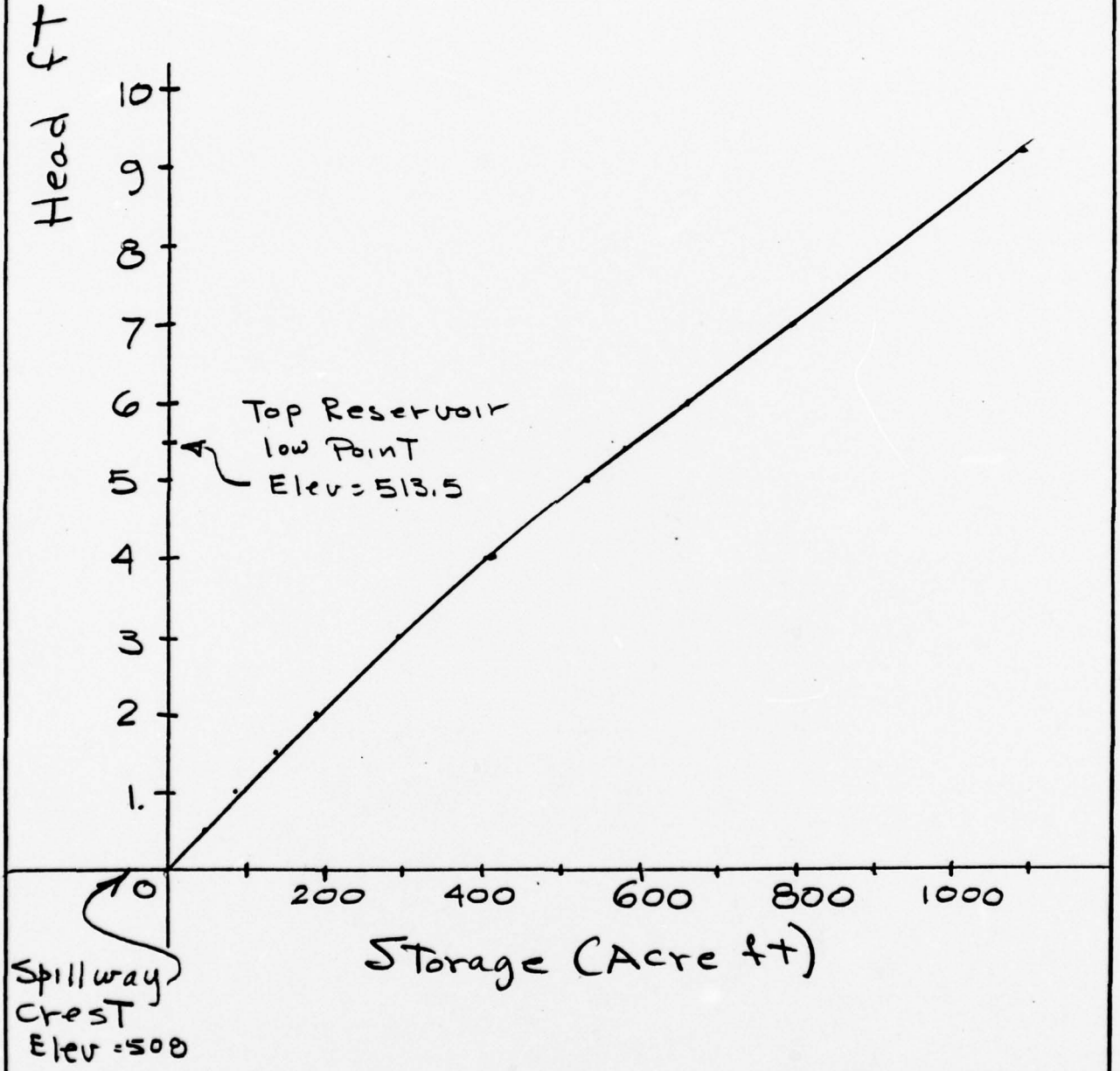
Elev	H (ft)	Area (acres)	Avg Area (acres)	Storage (acre-ft)
508	0	87.6		
508.5	0.5	91.3	89.5	45
509	1.0	95.0	91.3	91
509.5	1.5	98.7	93.2	140
510	2.0	102.4	95	190
511	3.0	109.8	98.7	296
512	4.0	117.2	102.4	410
513	5.0	124.6	106.1	531
514	6.0	132.0	109.8	659
515	7.0	139.4	113.5	795
517	9.0	154.2	120.9	1088

BY JC DATE 8/22 Indian JOB NO. J-783

CKD GED DATE 8/30 SHEET NO. 13 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

STORAGE CAPACITY CURVE
Indian lake



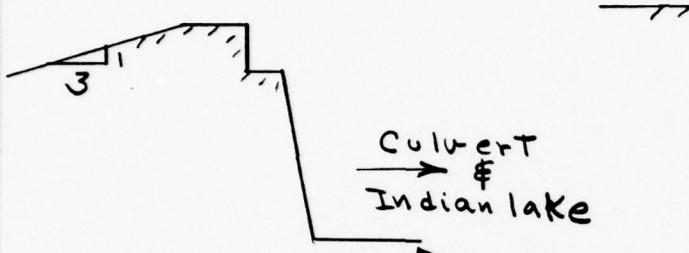
BY JC DATE 8/22 Indian JOB NO. J-783

CKD GED DATE 8/30 SHEET NO. 14 OF 25

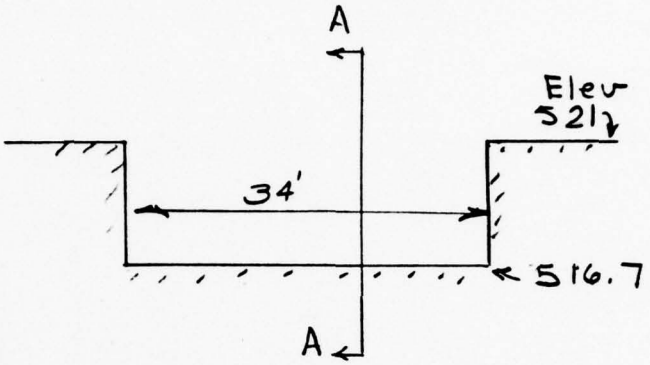
LANGAN ENGINEERING ASSOCIATES, INC.

SPILLWAY CAPACITY

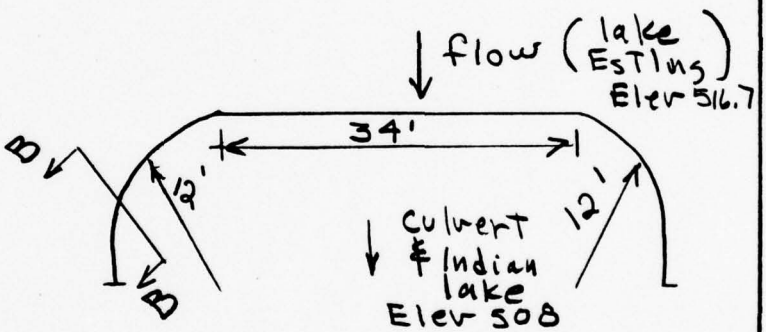
Lake ESTLing



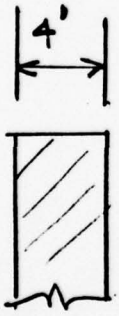
Section A-A



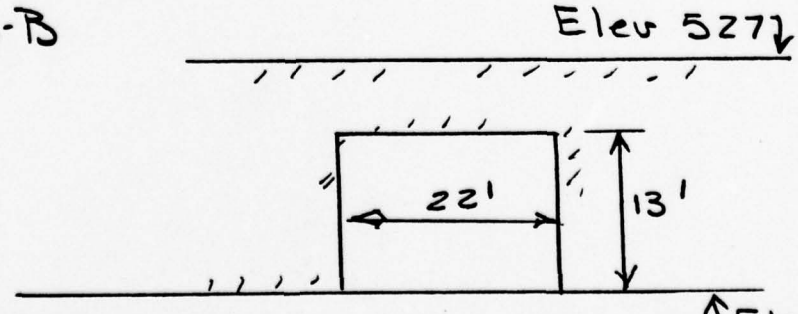
Elevation View



Plan View

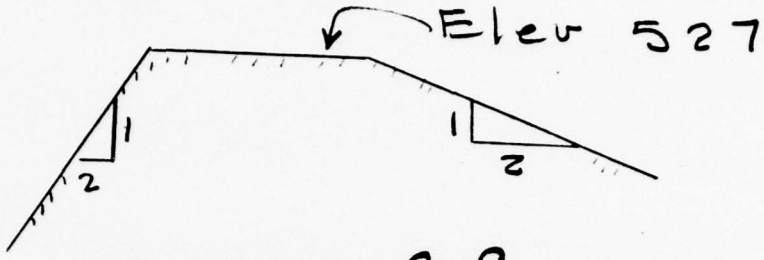


Section B-B



Upsteam face of culvert connecting lake EsTling To Indian lake

BY JC	DATE 8/22	Indian	JOB NO. J-783
CKD [illegible]	DATE 8/30		SHEET NO. 15 OF 25



Section C-C

Typical Cross Section of Railroad Crossing Dividing lake Estling from Indian lake

The flow will

(1) run over the spillway section A-A,

(2) then overtop and run over section BB, and

(3) finally run over the railroad tracks

Use Eq For Weir flow

$$Q = C L H^{3/2}$$

C will be determined from

LANGAN ENGINEERING ASSOCIATES, INC.

"Handbook of Hydraulics" King & Brater

for Spillway Section AA

pg 5-50, Table 5-13 $C_{avg} = 3.2$

$L = 34'$

Section BB pg 5-46 Table 5-3

$C_{avg} = 2.7$; $L = \pi R = \pi(12) \cong 38'$

Section CC pg 5-49, Table 5-9

$C_{avg} = 3.0$

The culvert capacity will be determined from "Open-Channel Hydraulics" - Chow Page 498 Fig 17-29. The culvert is flowing Partly full.

Top of Culvert at Elev = 521

Bottom of Culvert at Elev = 508

BY JC DATE 8/22 Indian JOB NO. J-783

CKD [illegible] DATE 8/30 SHEET NO. 17 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Elev (ft)	Spillway Section A-A H (ft)	Spillway Section A-A Q_A (cfs)	Spillway Section B-B H (ft)	Spillway Section B-B Q_B (cfs)	Reservoir H (ft)	Reservoir L (ft)	Reservoir Q_R (cfs)	Culvert H (ft)	Culvert H/D	Culvert Q/b	Culvert Q_C (cfs)	Q_{TOTAL} $Q_A+Q_B+Q_R$ OR Q_C+Q_R (cfs)
516.7	0											0
517.7	1	108.8										109
518.7	2	308										308
519.7	3	565										565
520.7	4	870										870
522.7	6	1599	1.7	227				14.7	1.13	175	3850	1826
524.7	8	2462	3.7	730				16.7	1.28	200	4400	3192
527.7	11	3969	6.7	1779	0.7	300	527	19.7	1.5	235	5170*	5697
528.7	12	4523	7.7	2192	1.7	600	3989	20.7	1.6	240	5280*	9269
530.7	14	5699	9.7	3100	3.7	800	17,081	22.7	1.75	270	5940*	22,958

* The culvert controls at this Elev.

BY JC DATE 8/22 Indian

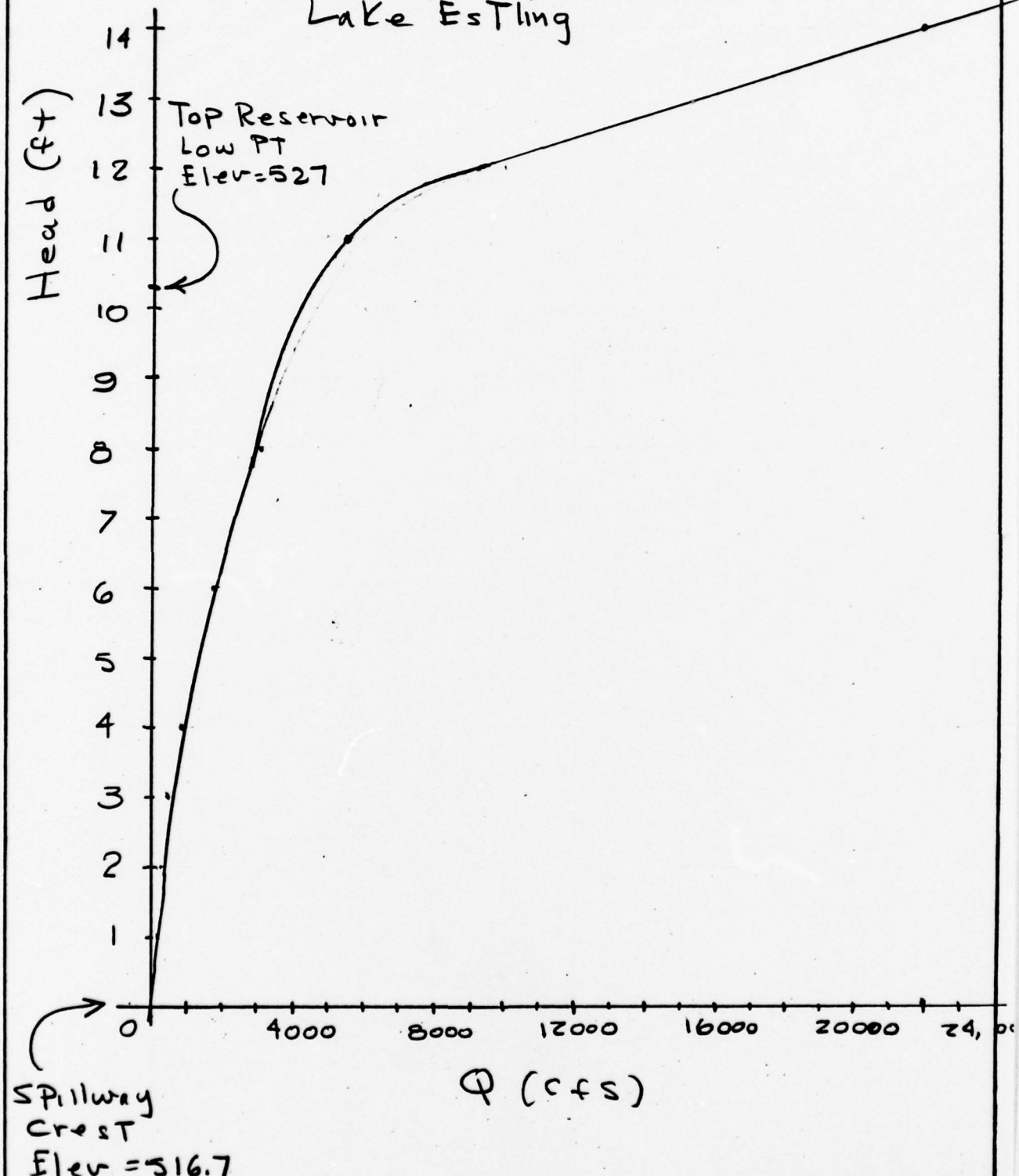
CKD CEB DATE 8/30

JOB NO. 1-783

SHEET NO. 18 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Spillway Capacity Curve
Lake Estling



BY JC DATE 8/22 Indian JOB NO. J-783

CKD [illegible] DATE 8/30 SHEET NO. 19 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Reservoir Storage Capacity (EsTling)

Assume a linear distribution for the increase in the area with elevation. Start at a zero storage at the crest of the spillway

Lake area (Elev 516.7) = 75 acres

Area Elev 520 = 90 acres

$\therefore$ Area increase per foot of Elev = $\frac{90-75}{520-516.7} = 4.5$ acres

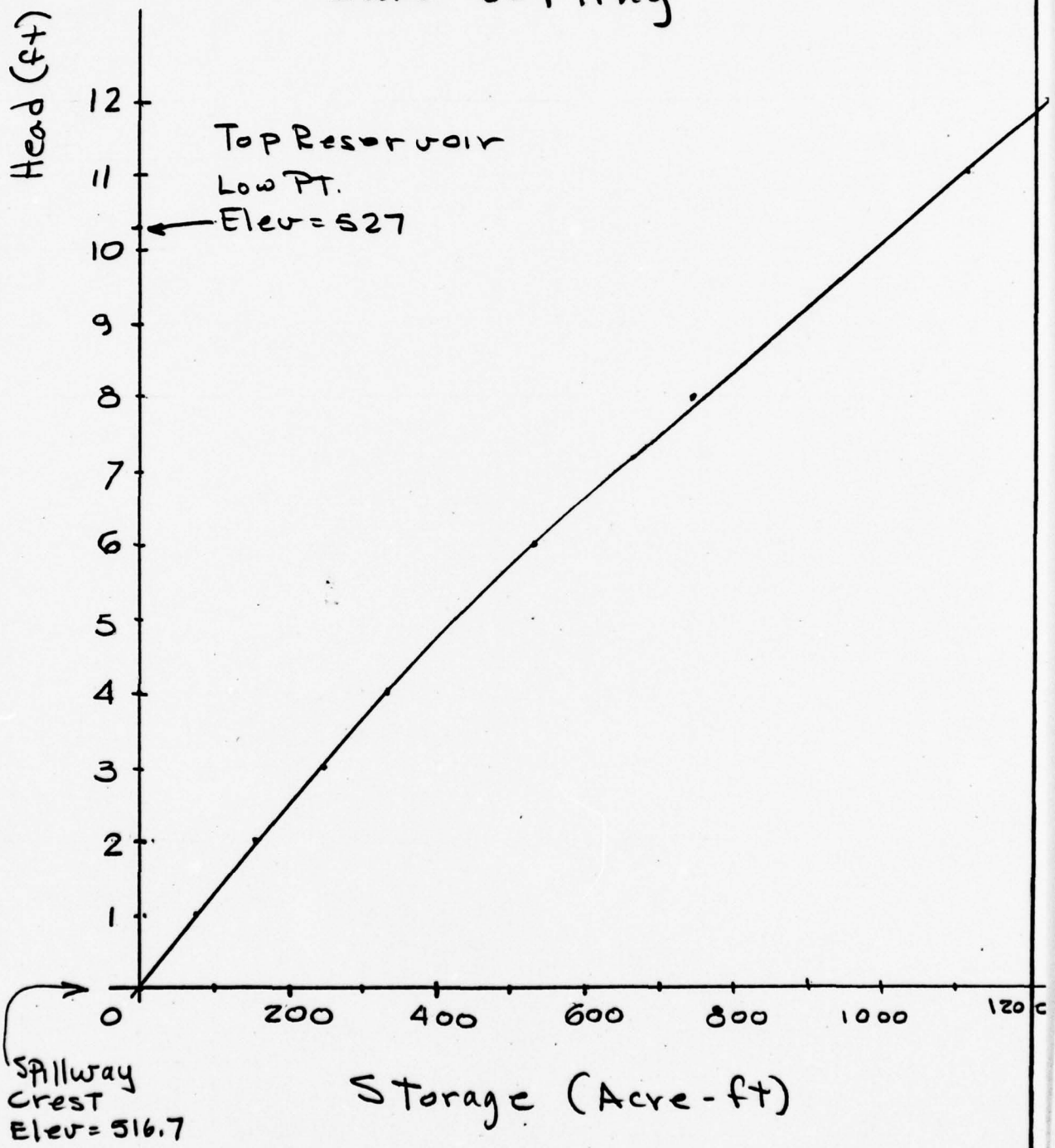
Elev (ft)	H (ft)	Area (acres)	Avg Area (acres)	Storage (acre-ft)
516.7	0	75		
517.7	1	79.5	77	77
518.7	2	84	80	159
519.7	3	88.5	82	245
520.7	4	93.0	84	336
522.7	6	102.0	88.5	531
524.7	8	111.0	93	744
527.7	11	124.5	99.5	1097
528.7	12	129.0	102.0	1224
530.7	14	138.0	106.5	1491

BY JC DATE 8/22 Indian JOB NO. J-783

CKD CED DATE 8/30 SHEET NO. 20 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

Storage Capacity Curve
Lake Estling



BY JC DATE 8/22 Indian JOB NO. J-783

CKD CED DATE 8/30 SHEET NO. 21 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

INDIAN LAKE SUMMARY

Elev	H ft	Q cfs	Storage
508	0	0	0
508.5	0.5	47	45
509.0	1.0	132	91
509.5	1.5	242	140
510.0	2	373	190
511.0	3	686	296
512.0	4	1056	410
513.5	5.5	1702	531
514.0	6	2046	659
515.0	7	3823	795
517.0	9	10439	1088

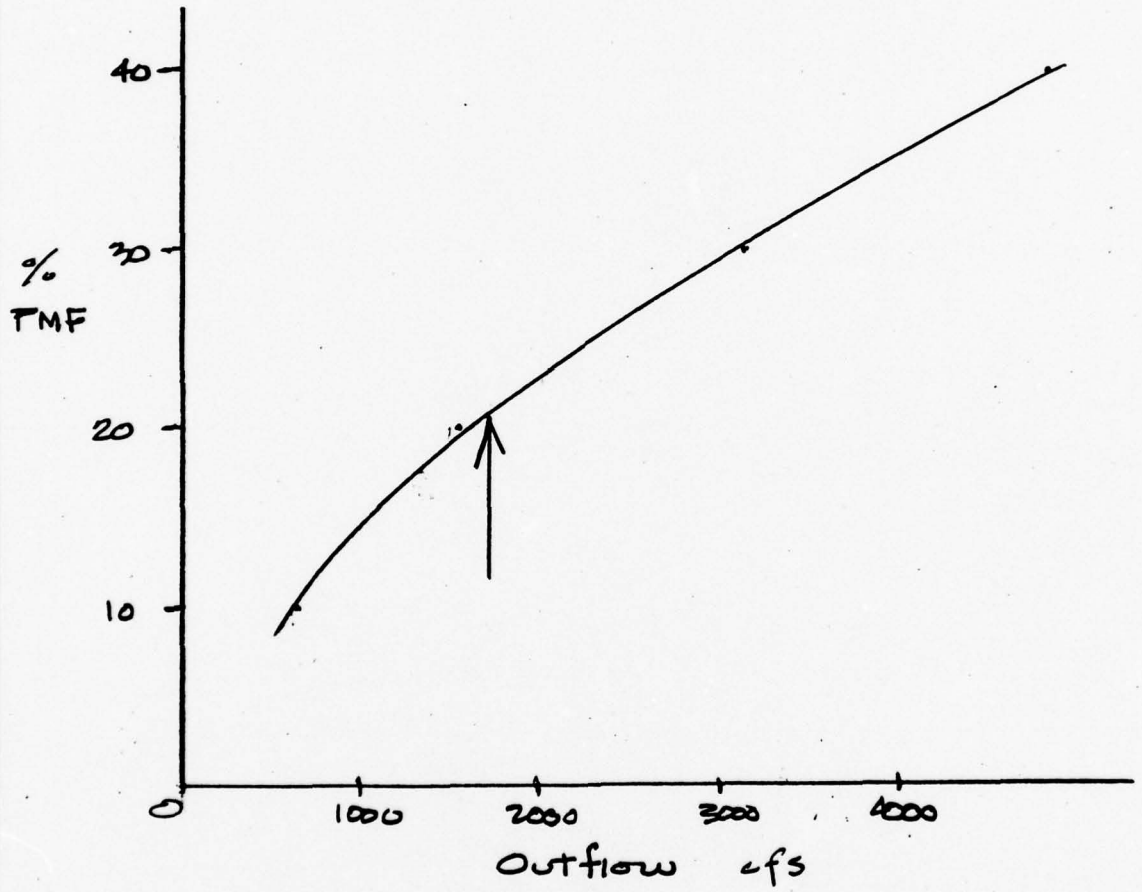
HYDROGRAPH AND FLOOD ROUTING

1. Hydrograph and flood routing determined using HEC 1
2. PMF for Indian Lake = 17400 cfs (routed to 16448)
3. Routing indicates dam will overtop by ≈ 4.0 ft for PMF

LANGAN ENGINEERING ASSOCIATES, INC.

OVERTOPPING POTENTIAL

1. Various % PMF have been routed (HEC 1, attached)
2. Plot peak outflow vs % PMF



3. Dam overtops at approx el 513.5 with Q = 1702 cfs
   ∴ dam can pass 20% PMF

BY JC DATE ____ INDIAN JOB NO. J-783
CKD KED DATE 6/30 SHEET NO. 23 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

DRAWDOWN ANALYSIS

1 Outlet structures - 2 24" ϕ CIP

invert = 499.0

tailwater elevation = 501.7

spillway crest = 508.

2. Storage between spillway crest and invert is estimated to approximately 700 ac ft. Assume area varies linearly with height and area @ 9' = 88 acres

Elev	Acres	Δ Storage	Total Storage
508	88		700
		86.84	
507	85.67		
		84.51	
506	83.34		
		82.18	
505	81.01		
		79.85	
504	78.68		
		77.5	
503	76.35		
		75.19	
502	74.02		
		72.86	
501	71.69		
		70.53	
500	69.36		
499	67.		0

$\left(\frac{88 + x}{2}\right) 9 = 700$ $x = 67$ area changes by 7.33 acre/ft

3. Outlet capacity

culvert flow - use BPR Hydraulic Circular #10

Elev	Head	Q 1 pipe	Q 2 pipes
508	6.3	29	58
507	5.3	25	50
506	4.3	22	44
505	3.3	19	38
504	2.3	14	28
503	1.3	6	12
502	0.3	1	2
501			

BY GED DATE ____ INDIAN JOB NO. J-783

CK GED DATE 8.30 SHEET NO. 24 OF 25

LANGAN ENGINEERING ASSOCIATES, INC.

4. Assume inflow to be 2 cfs/sq mi

$7.4 \times 2 = 14.8$ cfs

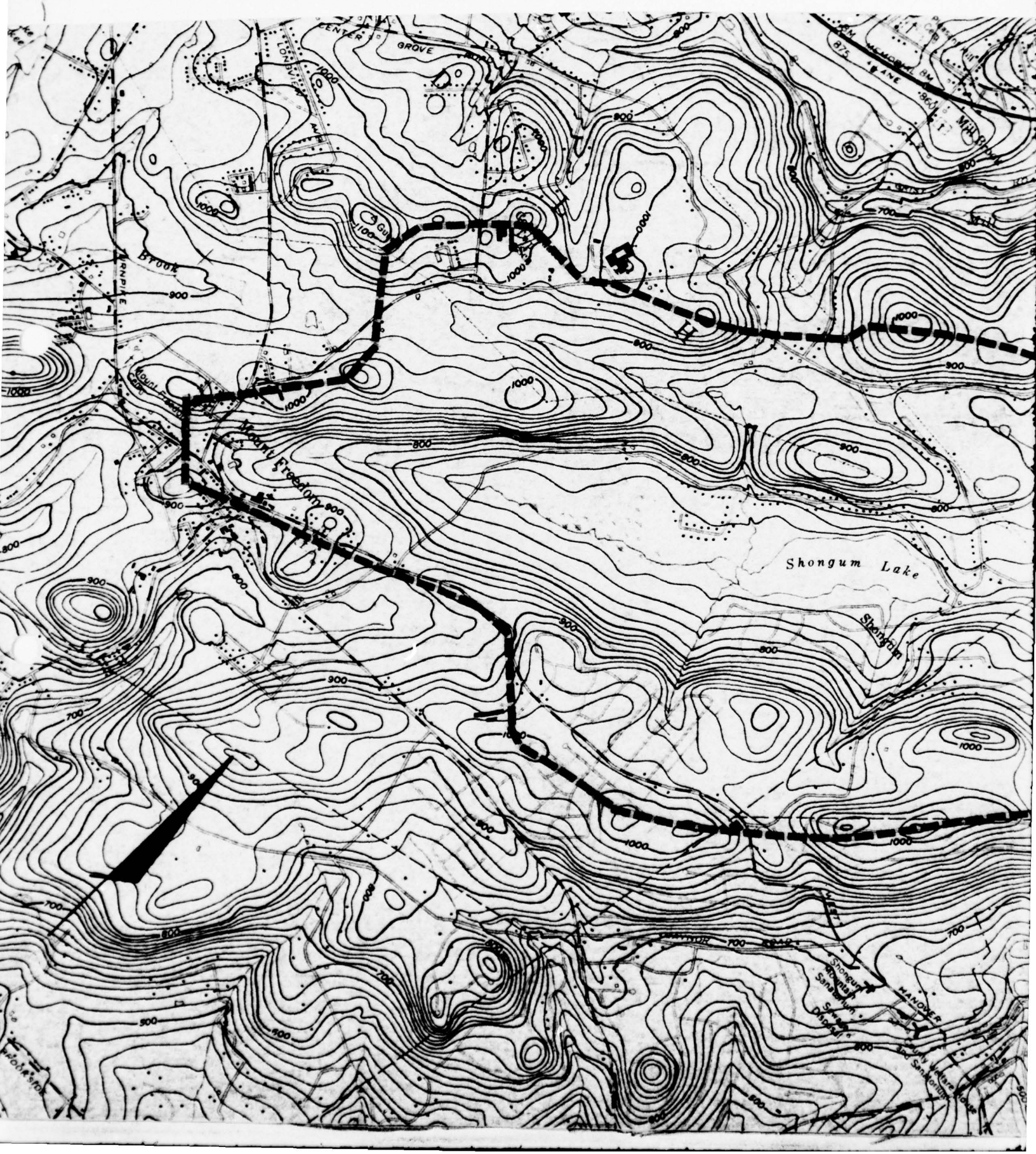
Elevation	Qout	Qavg	Qnet*	Storage	Δt hr	Σ Δt hr	Σ Δt days
508	58	54	39	86.84	26.9	58.89	2.45
507	50	47	32	84.5	31.95	92.09	3.84
506	44	41	26	82.1	38.2	149	6.22
505	38	33	18	77.5	62.1		
504	28	20	5**				
503	12	7					
502	2						

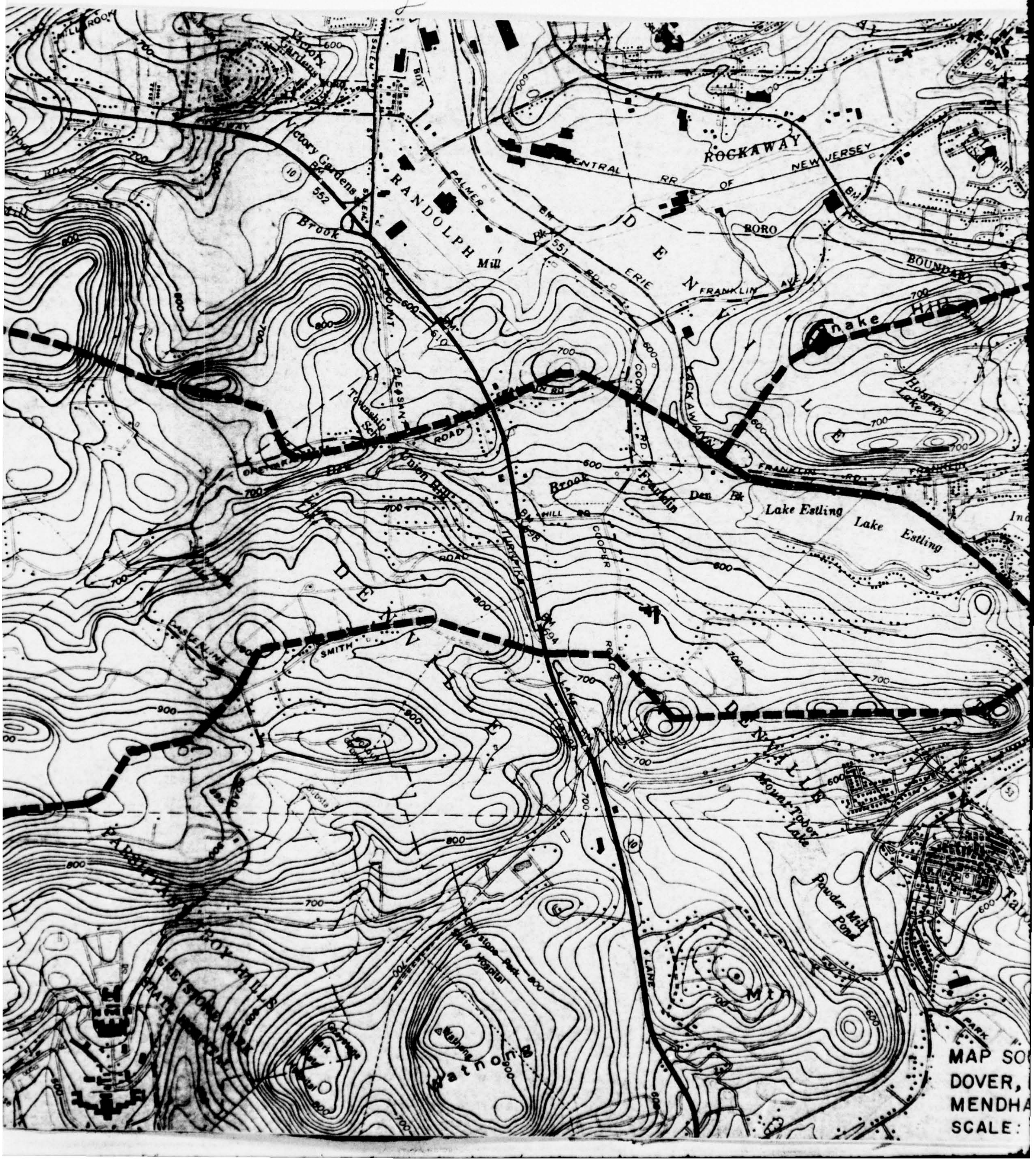
* $Q_{net} = Q_{out_{avg}} - 14$

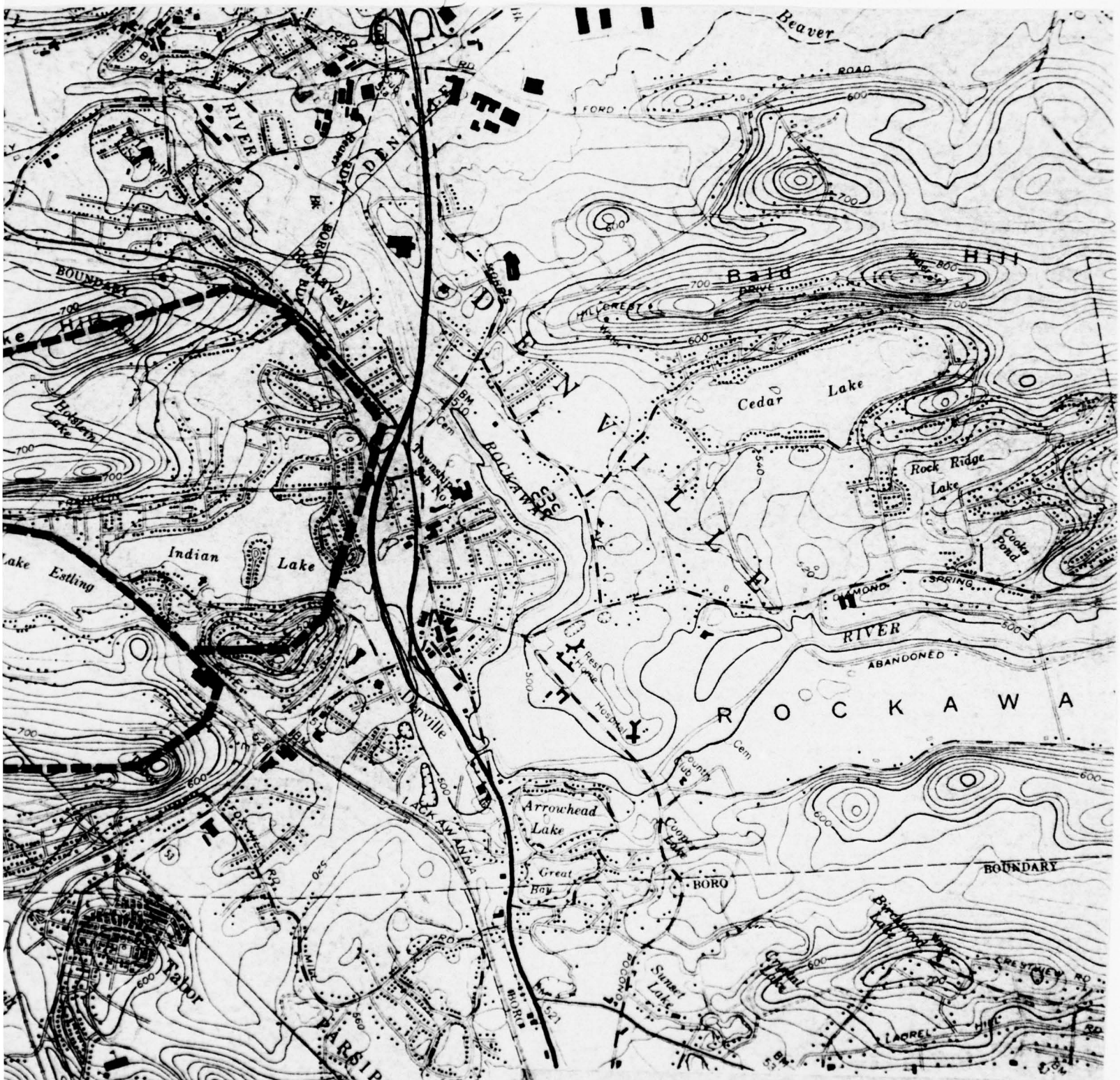
** Inflow becomes greater than outflow capacity
∴ lake level would stabilize at approx 505 and theoretically could be lowered to 501.7, the • to outlet elevation.

BY GED DATE 1/84 Indian JOB NO. J-783

CKD GED DATE 1/84 SHEET NO. 25 OF 25


CENTER GROVE
LONGVIEW AVE
Brook
Mount Freedom
Mount Freedom
Shongum Lake
Shongum
Shongum Sanatorium
Shongum Sanatorium
MANOR
MANOR
1000
900
800
700
500


Victory Gardens
ROCKAWAY
CENTRAL RR OF NEW JERSEY
RANDOLPH
BORO
BOUNDARY
ERIE
FRANKLIN AVE
PALMER
Brook
Mill
MOUNT PLEASANT ROAD
Township Sch
Union Hill
HILL RD
COOPER
LACKAWANNA
Snake Hill
Holstein Lake
Den Bk
Lake Estling
Lake Estling
SMITH
Mount Tabor Lake
Powder Mill Pond
Greystone Park State Hospital
Watnong
Mtn
MAP SO
DOVER,
MENDHA
SCALE:



DRAINAGE BASIN
INDIAN LAKE

LANGAN ENGINEERING ASSOCIATES, INC.
CONSULTING ENGINEERS
970 CLIFTON AVE. CLIFTON, N.J. 07012 201 472-9366

HEC-1 OUTPUT

INDIAN LAKE DAM

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 listcf ind20 'breakdown'-

IND20      19:43 AUG 30,'78

AMDS09 JOB 5538 (LANG0876) IN BREAKDOWN
 CDC1B          LANG0876      5538      FT06F001        16.48.56  30 AUG 78        GED                          GED

******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************

******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************
                    INDIAN LAKE DAM
                    DETERMINE INFLOW HYDROGRAPH % PMF-INDIAN LAKE
                    N.J. DAM INSPECTION

                                    JOB SPECIFICATION
                          NQ    NHR   NMIN   IDAY    IHR   IMIN METRC   IPLT   IPRT NSTAN
                         110      0     30      0      0      0      0      0      4      0
                                                JOPER      NWT
                                                    5        0


                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                     NPLAN# 1 NRTIO# 6 LRTIO# 1
                          RTIOS#   1.00   0.50   0.40   0.30   0.20   0.10


**********          **********          **********          **********          **********

                                SUB-AREA RUNOFF COMPUTATION

                    COMPUTE HYDROGRAPH-ESTLING
                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                                    1       0       0       0       0       0       1

                                            HYDROGRAPH DATA
                    IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                        1      -1    6.44     0.0    6.44    0.80     0.0       0       0       0

                                            PRECIP DATA
                              SPFE     PMS      R6     R12     R24     R48     R72     R96
                              0.0    22.50  112.00  123.00  132.00  142.00     0.0     0.0
```

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.20	0.0	0.0

RECESSION DATA

STRTQ# -2.00 QRCSN# 0.0 RTIOR# 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
SUM	25.40	19.93	165335.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING-ESTLING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE#	77.	159.	245.	336.	531.	744.	1097.	1224.	1491.	0.
OUTFLOW#	109.	308.	565.	870.	1826.	3192.	5697.	9269.	22958.	0.

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH-INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	0.96	0.0	0.96	0.80	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	106.00	116.00	125.00	137.00	0.0	0.0

0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.20	0.0	0.0

RECESSION DATA
STRTQ# -2.00 QRCSN# 0.0 RTIOR# 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
SUM	26.54	20.50	25592.

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE OUTFLOW OF ESTLING TO INFLOW OF INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	2	0	0	0	0	1

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
3	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE#	45.	91.	140.	190.	296.	410.	600.	659.	795.	1088.
OUTFLOW#	47.	132.	242.	373.	686.	1056.	1702.	2046.	3823.	10439.

********** ********** ********** ********** **********

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS 1.00	0.50	0.40	0.30	0.20	0.10

HYDROGRAPH AT	1	1	15319.	7659.	6128.	4596.	3064.	1532.
		2	0.	0.	0.	0.	0.	0.
ROUTED TO	1	1	15135.	6430.	4725.	3432.	2131.	892.
		2	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT	2	1	2914.	1457.	1166.	874.	583.	291.
		2	0.	0.	0.	0.	0.	0.
2 COMBINED	2	1	17403.	7162.	5263.	3798.	2335.	969.
		2	0.	0.	0.	0.	0.	0.
ROUTED TO	3	1	16448.	6647.	4873.	3124.	1547.	640.
		2	0.	0.	0.	0.	0.	0.

MCDONNELL DOUGLAS AUTOMATION COMPANY -- ST. LOUIS MESSAGE OF THE DAY

```
**********************************************************************************
*                                                                                *
*                              LABOR HOLIDAY SCHEDULE                            *
*                                                                                *
*       THE ST. LOUIS ASP/JES SYSTEMS WILL DISCONTINUE OPERATIONS AT             *
*       0830, SUNDAY, 3 SEPTEMBER.  NORMAL OPERATIONS WILL RESUME AT             *
*       0130, TUESDAY, 5 SEPTEMBER.                                              *
*                                                                                *
*       HAVE A HAPPY HOLIDAY.                                                    *
*                                                                                *
**********************************************************************************
```

MCDONNELL DOUGLAS AUTOMATION COMPANY -- ST. LOUIS
OS/MVT RELEASE 21.7 COMPUTER SYSTEM SY0

ASP JOB NO. = 5538 JOBNAME = LANG0876 START TIME = 16.45.12 START DATE = 08/30/78

* * * * * * * * * * * STEP RESOURCES * * * * * * * * * * *

STEPNAME	COND CODE	COMP CODE	CORE USED	REGION REQUEST	DASD TRKS	DISK UNITS	TAPE UNITS	DASD I/O (MIN)	TAPE I/O (MIN)	CPU (MIN)	STEP TIME (MIN)	STEP MRU
GO	0000		194 K	194 K	100	1	0	.158	.000	.005	.084	.32

* TOTAL JOB USAGE * * * * * * * MAIN RESOURCE UNIT SUMMARY * * * * * *

CPU (MIN)	I/O (MIN)	CPU USAGE (MRU)	RESOURCE OCCUPANCY (MRU) CORE	DASD TRKS	DISK UNITS	TAPE UNITS	INIT/TERM (MRU)	JOB TOTAL (MRU)
.005	.158	.05	.18	.00	.04	.00	.05	.32

********* ONE OR MORE STEPS IN THIS JOB UTILIZED A PROPRIETARY PACKAGE *********

CLIENT CHARGE NO. 1560972
CLIENT DEFINED SUB-ACC'TING

*** RUN LIMITS ***
CPU (MIN) .50 DEFAULT PROGRAMMER NAME FIELD
GED

```
 listcf ind10 'breakdown'-

IND10      19:12 AUG 30,'78

AMDS09 JOB 5529 (LANG0872) IN BREAKDOWN
 CDC1B          LANG0872      5529      FT06F001        16.46.39  30 AUG 78        GED                          GED

******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************

******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************
                    INDIAN LAKE DAM
                    DETERMINE INFLOW HYDROGRAPH FOR PMF- INDIAN LAKE DAM
                    N.J. DAM INSPECTION

                                        JOB SPECIFICATION
                              NQ    NHR   NMIN   IDAY    IHR   IMIN METRC   IPLT   IPRT NSTAN
                             110      0     30      0      0      0      0      0      0      0
                                                JOPER      NWT
                                                    3        0


          **********          **********          **********          **********          **********

                                        SUB-AREA RUNOFF COMPUTATION

                    COMPUTE HYDROGRAPH-ESTLING
                                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                                     1       0       0       0       0       0       1

                                                HYDROGRAPH DATA
                   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                       1      -1    6.44     0.0    6.44    0.80     0.0       0       0       0

                                                PRECIP DATA
                             SPFE     PMS      R6     R12     R24     R48     R72     R96
                              0.0   22.50  112.00  123.00  132.00  142.00     0.0     0.0

                                                LOSS DATA
                  STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                    0.0     0.0    1.00     0.0     0.0    1.00    1.00    0.20     0.0     0.0
```

GIVEN UNIT GRAPH, NUHGQ# 20

97.	387.	726.	1039.	1210.	1113.	944.	726.	508.	387.
290.	205.	169.	121.	85.	67.	48.	36.	24.	22.

UNIT GRAPH TOTALS 8204. CFS OR 0.99 INCHES OVER THE AREA

RECESSION DATA

STRTQ# -2.00 QRCSN# 0.0 RTIOR# 1.00

TIME	END-OF-PERIOD FLOW RAIN	EXCS	COMP Q
1	0.00	0.00	13.
2	0.00	0.00	13.
3	0.00	0.00	13.
4	0.00	0.00	13.
5	0.00	0.00	13.
6	0.00	0.00	13.
7	0.00	0.00	13.
8	0.00	0.00	13.
9	0.00	0.00	13.
10	0.00	0.00	13.
11	0.00	0.00	13.
12	0.00	0.00	13.
13	0.01	0.00	13.
14	0.01	0.00	13.
15	0.01	0.00	13.
16	0.01	0.00	13.
17	0.01	0.00	13.
18	0.01	0.00	13.
19	0.01	0.00	13.
20	0.01	0.00	13.
21	0.01	0.00	13.
22	0.01	0.00	13.
23	0.01	0.00	13.
24	0.01	0.00	13.
25	0.08	0.00	13.
26	0.08	0.00	13.
27	0.09	0.00	13.
28	0.09	0.00	13.
29	0.11	0.00	13.
30	0.11	0.00	13.
31	0.29	0.04	16.
32	0.29	0.19	45.
33	0.11	0.01	113.
34	0.11	0.01	191.
35	0.08	0.00	261.
36	0.08	0.00	295.
37	0.01	0.00	274.
38	0.01	0.00	234.
39	0.01	0.00	183.
40	0.01	0.00	135.

41	0.01	0.00	105.
42	0.01	0.00	82.
43	0.01	0.00	63.
44	0.01	0.00	53.
45	0.01	0.00	42.
46	0.01	0.00	33.
47	0.01	0.00	29.
48	0.01	0.00	24.
49	0.05	0.00	21.
50	0.05	0.00	19.
51	0.05	0.00	17.
52	0.05	0.00	13.
53	0.05	0.00	13.
54	0.05	0.00	13.
55	0.05	0.00	13.
56	0.05	0.00	13.
57	0.05	0.00	13.
58	0.05	0.00	13.
59	0.05	0.00	13.
60	0.05	0.00	13.
61	0.16	0.06	19.
62	0.16	0.06	44.
63	0.16	0.06	92.
64	0.16	0.06	159.
65	0.16	0.06	238.
66	0.16	0.06	310.
67	0.16	0.06	371.
68	0.16	0.06	419.
69	0.16	0.06	452.
70	0.16	0.06	477.
71	0.16	0.06	496.
72	0.16	0.06	509.
73	1.01	0.91	602.
74	1.01	0.91	936.
75	1.21	1.11	1573.
76	1.21	1.11	2531.
77	1.51	1.41	3730.
78	1.51	1.41	4997.
79	3.83	3.73	6483.
80	3.83	3.73	8532.
81	1.41	1.31	10965.
82	1.41	1.31	13247.
83	1.11	1.01	14899.
84	1.11	1.01	15319.
85	0.08	0.00	14617.
86	0.08	0.00	13164.
87	0.08	0.00	11153.
88	0.08	0.00	9052.
89	0.08	0.00	7098.
90	0.08	0.00	5375.
91	0.08	0.00	4015.

92	0.08	0.00	2996.
93	0.08	0.00	2204.
94	0.08	0.00	1629.
95	0.08	0.00	1198.
96	0.08	0.00	883.
97	0.0	0.0	626.
98	0.0	0.0	448.
99	0.0	0.0	290.
100	0.0	0.0	158.
101	0.0	0.0	102.
102	0.0	0.0	59.
103	0.0	0.0	35.
104	0.0	0.0	13.
105	0.0	0.0	13.
106	0.0	0.0	13.
107	0.0	0.0	13.
108	0.0	0.0	13.
109	0.0	0.0	13.
110	0.0	0.0	13.
SUM	25.40	19.93	165335.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15319.	10825.	3387.	1503.	165328.
INCHES		15.64	19.57	19.90	19.90
AC-FT		5371.	6721.	6835.	6835.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING-ESTLING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE#	77.	159.	245.	336.	531.	744.	1097.	1224.	1491.	0.
OUTFLOW#	109.	308.	565.	870.	1826.	3192.	5697.	9269.	22958.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	1.	13.	0.
2	1.	13.	0.
3	2.	13.	0.

5	3.	13.	0.
6	3.	13.	0.
7	4.	13.	0.
8	4.	13.	0.
9	5.	13.	0.
10	5.	13.	0.
11	6.	13.	0.
12	6.	13.	0.
13	7.	13.	0.
14	7.	13.	0.
15	8.	13.	0.
16	9.	13.	0.
17	9.	13.	0.
18	10.	13.	0.
19	10.	13.	0.
20	11.	13.	0.
21	11.	13.	0.
22	12.	13.	0.
23	12.	13.	0.
24	13.	13.	0.
25	13.	13.	0.
26	14.	13.	0.
27	14.	13.	0.
28	15.	13.	0.
29	15.	13.	0.
30	16.	13.	0.
31	17.	15.	0.
32	18.	31.	0.
33	21.	79.	0.
34	27.	152.	0.
35	37.	226.	11.
36	47.	278.	36.
37	57.	284.	60.
38	64.	254.	79.
39	70.	209.	91.
40	72.	159.	97.
41	73.	120.	100.
42	73.	93.	99.
43	72.	72.	96.
44	70.	58.	93.
45	69.	47.	88.
46	67.	37.	84.
47	64.	31.	79.
48	62.	27.	74.
49	60.	23.	69.
50	58.	20.	64.
51	57.	18.	60.
52	55.	15.	55.
53	53.	13.	51.
54	52.	13.	48.
55	50	13	44

56	49.	13.	41.
57	48.	13.	39.
58	47.	13.	36.
59	46.	13.	34.
60	45.	13.	32.
61	45.	16.	30.
62	45.	32.	31.
63	46.	68.	34.
64	50.	125.	43.
65	56.	198.	58.
66	64.	274.	78.
67	75.	341.	103.
68	86.	395.	131.
69	98.	435.	160.
70	110.	464.	189.
71	122.	486.	218.
72	133.	502.	245.
73	145.	555.	274.
74	165.	769.	325.
75	201.	1254.	433.
76	264.	2052.	627.
77	360.	3131.	986.
78	486.	4364.	1607.
79	638.	5740.	2515.
80	820.	7507.	3729.
81	1037.	9749.	5268.
82	1230.	12106.	9579.
83	1320.	14073.	14202.
84	1338.	15109.	15135.
85	1335.	14968.	14963.
86	1314.	13891.	13860.
87	1279.	12158.	12109.
88	1239.	10102.	10045.
89	1192.	8075.	8375.
90	1136.	6236.	6803.
91	1075.	4695.	5543.
92	1002.	3506.	5022.
93	915.	2600.	4402.
94	825.	1916.	3767.
95	740.	1414.	3167.
96	663.	1041.	2670.
97	593.	755.	2222.
98	531.	537.	1827.
99	476.	369.	1559.
100	426.	224.	1313.
101	382.	130.	1096.
102	344.	81.	909.
103	311.	47.	786.
104	281.	24.	687.
105	255.	13.	600.
106	233.	13.	528.

107	213.	13.	468.
108	195.	13.	415.
109	179.	13.	368.
110	165.	13.	327.
SUM			161490.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15135.	10075.	3329.	1468.	161490.
INCHES		14.55	19.23	19.44	19.44
AC-FT		4999.	6605.	6677.	6677.

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH-INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	0.96	0.0	0.96	0.80	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	106.00	116.00	125.00	137.00	0.0	0.0

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.20	0.0	0.0

GIVEN UNIT GRAPH, NUHGQ# 14

46.	177.	284.	255.	174.	116.	70.	46.	28.	17.
12.	6.	5.	3.						

UNIT GRAPH TOTALS 1239. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ# -2.00 QRCSN# 0.0 RTIOR# 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.01	0.00	2.
2	0.01	0.00	2.
3	0.01	0.00	2.
4	0.01	0.00	2.
5	0.01	0.00	2.
6	0.01	0.00	2.
7	0.01	0.00	2.

8	0.01	0.00	2.
9	0.01	0.00	2.
10	0.01	0.00	2.
11	0.01	0.00	2.
12	0.01	0.00	2.
13	0.02	0.00	2.
14	0.02	0.00	2.
15	0.02	0.00	2.
16	0.02	0.00	2.
17	0.02	0.00	2.
18	0.02	0.00	2.
19	0.02	0.00	2.
20	0.02	0.00	2.
21	0.02	0.00	2.
22	0.02	0.00	2.
23	0.02	0.00	2.
24	0.02	0.00	2.
25	0.10	0.00	2.
26	0.10	0.00	2.
27	0.12	0.00	2.
28	0.12	0.00	2.
29	0.15	0.00	2.
30	0.15	0.00	2.
31	0.37	0.25	14.
32	0.37	0.27	59.
33	0.14	0.04	123.
34	0.14	0.04	151.
35	0.11	0.01	132.
36	0.11	0.01	100.
37	0.01	0.00	70.
38	0.01	0.00	47.
39	0.01	0.00	31.
40	0.01	0.00	20.
41	0.01	0.00	14.
42	0.01	0.00	9.
43	0.01	0.00	6.
44	0.01	0.00	5.
45	0.01	0.00	3.
46	0.01	0.00	2.
47	0.01	0.00	2.
48	0.01	0.00	2.
49	0.06	0.00	2.
50	0.06	0.00	2.
51	0.06	0.00	2.
52	0.06	0.00	2.
53	0.06	0.00	2.
54	0.06	0.00	2.
55	0.06	0.00	2.
56	0.06	0.00	2.
57	0.06	0.00	2.
58	0.06	0.00	2.

59	0.06	0.00	2.
60	0.06	0.00	2.
61	0.16	0.06	5.
62	0.16	0.06	15.
63	0.16	0.06	32.
64	0.16	0.06	48.
65	0.16	0.06	58.
66	0.16	0.06	65.
67	0.16	0.06	69.
68	0.16	0.06	72.
69	0.16	0.06	74.
70	0.16	0.06	75.
71	0.16	0.06	75.
72	0.16	0.06	76.
73	1.02	0.92	116.
74	1.02	0.92	268.
75	1.22	1.12	520.
76	1.22	1.12	775.
77	1.53	1.43	996.
78	1.53	1.43	1202.
79	3.87	3.77	1491.
80	3.87	3.77	2047.
81	1.42	1.32	2690.
82	1.42	1.32	2914.
83	1.12	1.02	2651.
84	1.12	1.02	2269.
85	0.09	0.00	1889.
86	0.09	0.00	1464.
87	0.09	0.00	1021.
88	0.09	0.00	655.
89	0.09	0.00	418.
90	0.09	0.00	259.
91	0.09	0.00	161.
92	0.09	0.00	102.
93	0.09	0.00	57.
94	0.09	0.00	31.
95	0.09	0.00	17.
96	0.09	0.00	10.
97	0.0	0.0	5.
98	0.0	0.0	2.
99	0.0	0.0	2.
100	0.0	0.0	2.
101	0.0	0.0	2.
102	0.0	0.0	2.
103	0.0	0.0	2.
104	0.0	0.0	2.
105	0.0	0.0	2.
106	0.0	0.0	2.
107	0.0	0.0	2.
108	0.0	0.0	2.
109	0.0	0.0	2.

110 0.0 0.0 2.

SUM 26.54 20.50 25592.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2914.	1784.	515.	233.	25590.
INCHES		17.29	19.96	20.66	20.66
AC-FT		885.	1022.	1058.	1058.

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COMBINE HYDROGRAPHS

COMBINE OUTFLOW OF ESTLING TO INFLOW OF INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	2	0	0	0	0	1

SUM OF 2 HYDROGRAPHS AT 2

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
14.	59.	123.	151.	143.	136.	130.	126.	122.	118.
113.	108.	103.	98.	92.	86.	81.	76.	71.	66.
62.	57.	53.	50.	46.	43.	41.	38.	36.	34.
35.	46.	66.	90.	116.	143.	173.	203.	234.	264.
293.	321.	390.	592.	953.	1403.	1982.	2809.	4006.	5775.
7959.	12494.	16853.	17403.	16852.	15324.	13130.	10700.	8793.	7062.
5704.	5123.	4460.	3797.	3184.	2680.	2226.	1829.	1561.	1315.
1097.	911.	788.	689.	602.	530.	470.	417.	370.	329.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	17403.	11504.	3843.	1701.	187080.
INCHES		14.46	19.32	19.60	19.60
AC-FT		5707.	7626.	7735.	7735.

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HYDROGRAPH ROUTING

ROUTE INDIAN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
3	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE#	45.	91.	140.	190.	296.	410.	600.	659.	795.	1088.
OUTFLOW#	47.	132.	242.	373.	686.	1056.	1702.	2046.	3823.	10439.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	2.	0.
2	0.	2.	0.
3	0.	2.	0.
4	0.	2.	0.
5	0.	2.	0.
6	0.	2.	0.
7	1.	2.	0.
8	1.	2.	0.
9	1.	2.	0.
10	1.	2.	0.
11	1.	2.	0.
12	1.	2.	0.
13	1.	2.	0.
14	1.	2.	0.
15	1.	2.	0.
16	1.	2.	0.
17	1.	2.	0.
18	1.	2.	0.
19	2.	2.	0.
20	2.	2.	0.
21	2.	2.	0.
22	2.	2.	0.
23	2.	2.	0.
24	2.	2.	0.
25	2.	2.	0.
26	2.	2.	0.
27	2.	2.	0.
28	2.	2.	0.
29	2.	2.	0.
30	2.	2.	0.
31	3.	8.	0.
32	4.	36.	0.
33	8.	91.	0.
34	14.	137.	0.
35	20.	147.	0.
36	25.	140.	11.
37	30.	133.	20.
38	34.	128.	28.
39	38.	124.	35.
40	42.	120.	41.
41	45.	115.	46.
42	47.	111.	51.
43	49.	106.	55.
44	51.	100.	58.

45	53.	95.	61.
46	54.	89.	63.
47	55.	83.	65.
48	55.	78.	66.
49	55.	73.	66.
50	55.	68.	66.
51	55.	64.	66.
52	55.	59.	66.
53	55.	55.	65.
54	54.	51.	64.
55	54.	48.	63.
56	53.	45.	61.
57	52.	42.	60.
58	51.	39.	58.
59	50.	37.	57.
60	49.	35.	55.
61	49.	35.	54.
62	48.	40.	53.
63	48.	56.	53.
64	49.	78.	55.
65	51.	103.	58.
66	54.	130.	64.
67	58.	158.	71.
68	62.	188.	79.
69	68.	219.	89.
70	74.	249.	101.
71	81.	279.	114.
72	89.	307.	128.
73	98.	355.	148.
74	112.	491.	178.
75	135.	773.	231.
76	172.	1178.	326.
77	226.	1692.	478.
78	300.	2396.	700.
79	405.	3408.	1040.
80	554.	4891.	1545.
81	741.	6867.	3119.
82	949.	10226.	7292.
83	1157.	14673.	11988.
84	1301.	17128.	15259.
85	1354.	17128.	16448.
86	1344.	16088.	16219.
87	1288.	14227.	14952.
88	1202.	11915.	13020.
89	1110.	9747.	10937.
90	1025.	7928.	9022.
91	951.	6383.	7343.
92	897.	5414.	6116.
93	859.	4792.	5273.
94	827.	4129.	4545.
95	797	3491	3874

AD-A058 820 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. INDIAN LAKE DAM (NJ00167), PASSAIC--ETC(U)
AUG 78 D J LEARY DACW61-78-C-0124
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96	767.	2932.	3457.
97	734.	2453.	3030.
98	702.	2028.	2604.
99	672.	1695.	2217.
100	645.	1438.	1965.
101	617.	1206.	1802.
102	587.	1004.	1658.
103	556.	849.	1552.
104	524.	738.	1445.
105	494.	645.	1340.
106	464.	566.	1239.
107	435.	500.	1142.
108	408.	443.	1050.
109	383.	394.	968.
110	359.	350.	890.
SUM			178678.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16448.	11156.	3692.	1624.	178678.
INCHES		14.02	18.57	18.72	18.72
AC-FT		5535.	7327.	7387.	7387.

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RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	15319.	10825.	3387.	1503.	6.44
ROUTED TO	1	15135.	10075.	3329.	1468.	6.44
HYDROGRAPH AT	2	2914.	1784.	515.	233.	0.96
2 COMBINED	2	17403.	11504.	3843.	1701.	7.40
ROUTED TO	3	16448.	11156.	3692.	1624.	7.40

MCDONNELL DOUGLAS AUTOMATION COMPANY -- ST. LOUIS MESSAGE OF THE DAY

LABOR HOLIDAY SCHEDULE

THE ST. LOUIS ASP/JES SYSTEMS WILL DISCONTINUE OPERATIONS AT 0830, SUNDAY, 3 SEPTEMBER. NORMAL OPERATIONS WILL RESUME AT 0130, TUESDAY, 5 SEPTEMBER.

HAVE A HAPPY HOLIDAY.

APPENDIX 4

REFERENCES

INDIAN LAKE DAM

APPENDIX 4

REFERENCES

INDIAN LAKE DAM

Written Documents

1. "Contract and Specifications covering Construction of Earth Dam, Concrete Spillway and Bridge at Denville, New Jersey for Joseph B. Righter, Esq." dated 2 August 1921.

2. Sheet 2 of Revised Spillway Capacity Calculations.

3. Memorandum on Changes in Plans for Proposed Lenapi Lake Dam for J.B. Righter, Denville, New Jersey, dated 19 August 1921.

4. Monthly Construction Progress Reports dated 30 September and 31 October 1921.

5. Inspection Report - Letter dated 21 October 1921 to Mr. A.B. Cohen from Hydraulic Engineer Mr. H.T. Critchlow.

6. Letter to H.T. Critchlow from A.B. Cohen concerning gate valve., dated 26 October 1921.

7. Memorandum regarding Construction Inspection of dam on 3 November 1921 from H.T. Critchlow.

8. Memorandum regarding inspection of dam construction 21 December 1921 from H.T. Critchlow.

9. Letter concerning dam inspections from D.C. Hofmann, Chief Bureau of Water Control to Frank Vanone, Denville Twp. Administrator, dated 12 September 1972.

Drawings

1. General Layout and Details of Proposed Lenapi Lake and Dam, dated 19 July 1921

2. General Layout and Details of Proposed Lanapi Lake and Dam, Revised 18 August 1921.

APPENDIX 4 Cont'd

INDIAN LAKE DAM

Other

1. Eby, C.F., 1976, Soil Survey of Morris County, New Jersey, U.S. Department of Agriculture, Soil Conservation Service, 111 pp.

2. Lewis, J.V., and H.B. Kummel, 1924, The Geology of New Jersey, Bulletin 14, Geological Survey of New Jersey, Trenton, New Jersey, 146 pp.

3. Lucey, C.S., 1972, Geology of Morris County in Brief, State of New Jersey, Bureau of Geology and Topography, Trenton, New Jersey, 13 pp.

4. Minard, J.P., W.W. Holman, A.R. Jumikis, 1953, Engineering Soil Survey of New Jersey, Report No. 9, Morris County, Rutgers University, New Brunswick, New Jersey, 86 pp.

5. Rogers, F.C., D.R. Lueder, and G.H. Obear, 1951, Engineering Soil Survey of New Jersey, Report No. 3, Passaic County, Rutgers University, New Brunswick, New Jersey, 45 pp.

6. Widmer, K., 1964, The GEology and GEography of New Jersey, Volume 19, The New Jersey Historical Series, D. Van Nostrand Co., Inc., Princeton, New Jersey, 193 pp.

7. Wolfe, P.E., 1977, The Geology and Landscapes of New Jersey, Crane, Russak & Company, Inc., New York, New York 351 pp.